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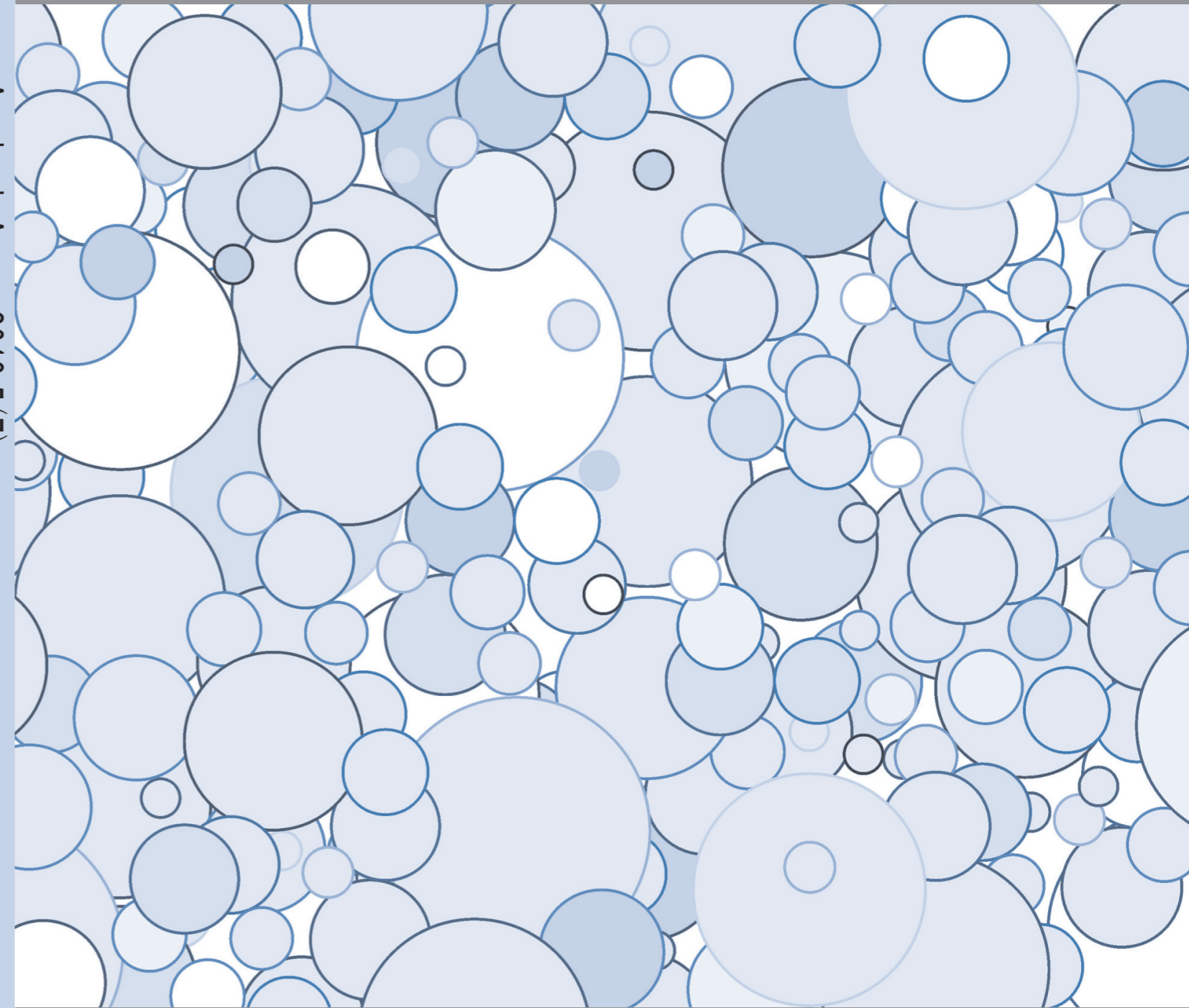
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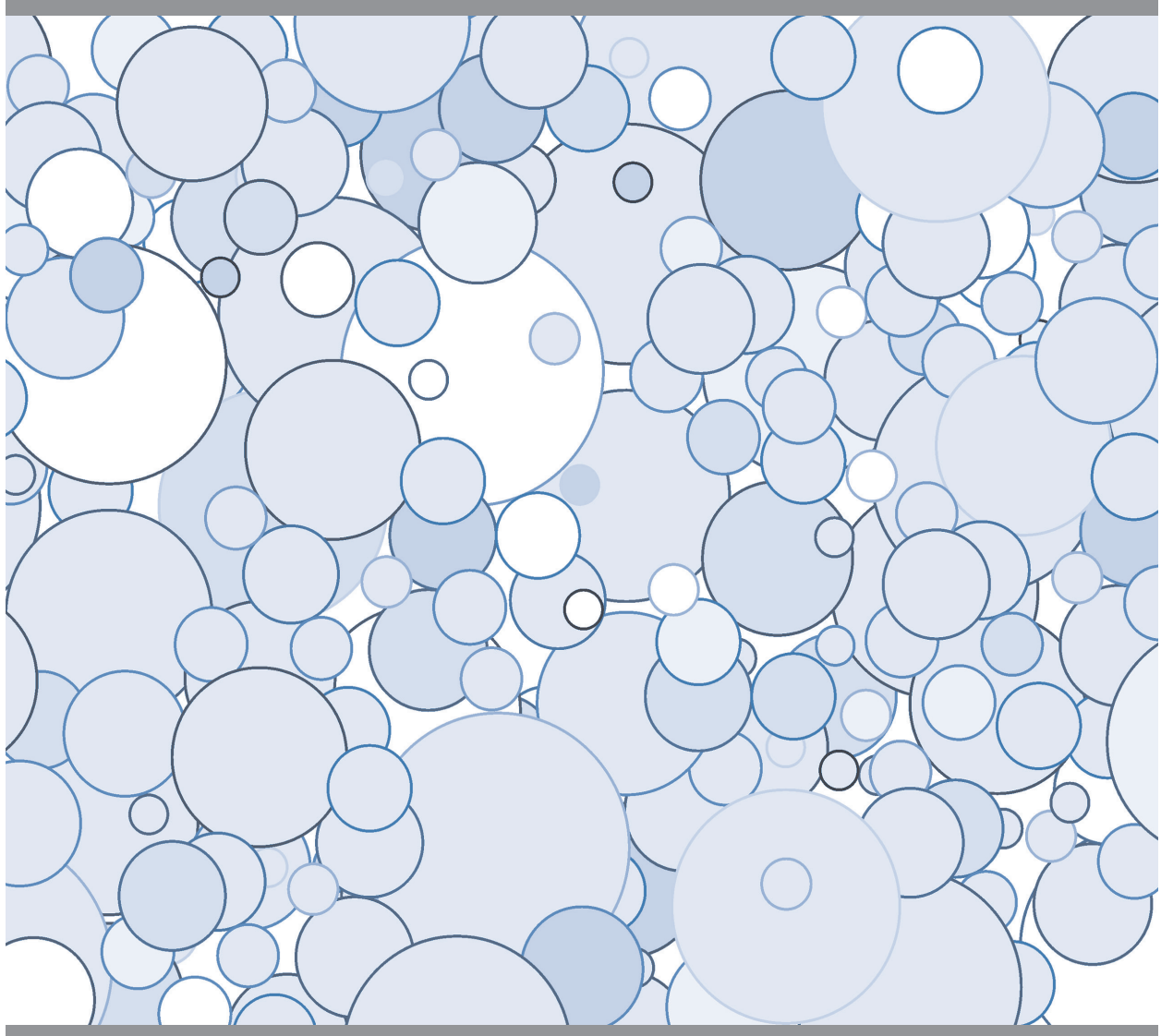
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# Academia Arena

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## The Growth Rate And Survival Of *Clarias Gariepinus* Fingerlings In Tap, Borehole And Stream Waters

Emmanuel. C. A And Solomon, R.J

Department of Biological Sciences, Faculty of Science, University of Abuja  
Abuja-Nigeria  
[Johnsol2004@yahoo.com](mailto:Johnsol2004@yahoo.com)

**ABSTRACT:** *Clarias gariepinus* fingerlings with initial mean weights and total lengths of 0 - 20g and 0 - 15cm were stocked in six glass aquaria with a circumference of 48 x 30 x 24cm each. There were three treatments namely A (containing tap water) used as control, B (borehole water) and treatment C (stream water) were stocked with 12 *Clarias gariepinus* fingerlings in each aquarium and reared for 60 days. The aim is to calculate the growth and survival of *C. gariepinus* fingerlings. The physiological parameters monitored were within tolerable ranges e.g. temperature, pH, dissolved oxygen, conductivity, ammonia, and nitrite concentration. The mean total length and weight A (19.76cm), B (17.55cm) and for C (15.55cm) while their mean weights were 44.83g, 28.92g and 25.46g for A, B and C respectively. The mean total length and mean weight of *Clarias gariepinus* showed no significant difference ( $p < 0.05$ ) Also there was no significant difference in the excluding the mean weight gain and survival rate which favored tap in relation to a higher growth and survival.

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### 1. INTRODUCTION

Nigeria is blessed with an estimated inland water mass of about 12.5million hectares capable of producing over 512,000 tons of fish annually (Ita, 1980). Available statistic shows. However, that our inland water bodies are currently production less than 50% of their estimated fishing potential. The greatest obstacles to increased inland fish production is the haphazard methods of exploitation due to non enforcement of established inland fisheries laws and regulations in the country coupled with the inadequate stocking of small man – made reveries (Ita, 1986)

Fish is an important component of total human food and to a lesser degree of animal feed it has been found nutritionally to be better than meat in terms of the quality of protein content with good amino acid profile. It has also been found rich in essential amino acids and minerals, and low in saturated fatty acids. Thus, the culture of fish has become an innovative technology aimed at producing large quantity of fish food the ever increasing human population in Nigeria.

One of the major constraints of aquaculture development is non availability of healthy and viable fingerlings which can be tended, nurtured, groomed and fed to marketable or table size (Indohiboyeobu and Ayinla, 1991).

Fish is responsible for about 55% of the protein intake sources of Nigerian populace. The national fish demand of at least 1.5 million metric tons annually is under – supplied to an extent that a

demand – production gap of 1.0 million metric tones exist. Aquaculture which promises the most renewable and sustainable option in protein food source supplies 2% of the national demand currently. This is because aquaculture development in Nigeria has so far been constrained generally by inappropriate technologies on the production essentials of the three F<sub>s</sub> namely feed, fish and filtration. These gaps have discouraged the needed investment in fish farm production from the private sector.

Aquaculture is important with regards to improving the diet of people, generating employment in rural areas, and saving foreign exchange through fish import substitution (Okoye, 1986).

Although fish pond culture activities in Nigeria is nearly 50 years old, the practice is still undertaken at subsistent level by private individuals, with very few at commercial levels and at the experimental or demonstration level by some government agencies. The availability of cheap, balanced, very affordable fish feed, and seeds of indigenous cultural species cannot be overemphasized in aquaculture. These are not yet enough for our aquaculture industries. Perhaps, the biggest challenge facing this industry is lake of trained personnel in virtually all specialized aspect of aquaculture.

It has been stated by Teugels (1986) that the natural habitat for *Clarias gariepinus* is fresh water bodies such as streams, lakes and rivers etc. such water sources are not readily available everywhere

for the production of *Clarias gariepinus* fish species on a commercial scale. this make the use of other available water source such as bore hole and tap waters optional. It is for this reason that this research is conducted to determine and compare the growth performance and survival of *Clarias gariepinus* in tap, bore hole and stream waters. This is aimed at knowing which of the water sources will give the greatest fish productivity and survival.

## 2.0 LITERATURE REVIEW

### 2.1 Geographical distribution

*Clarias gariepinus* or African sharp tooth catfish is a species of catfish of the family of *claridae*, the air breathing catfishes (Burchell, 1822). They are found throughout Africa and the Middle East where they inhabit fresh waters such as tropical swamps, lakes and rivers, some of which are liable to seasonal dryness. The African catfish has been moved all over the world in the early 80s for rearing purposes and is therefore found in countries far outside its natural habitat like Brazil, Vietnam, and India. In the Northern and central parts of Africa, it has been described as *clarias lazera*, in the western part as *clarias senegalesis*, in the Eastern part as *Clarias mossambicus*, and in the Southern part as *Clarias gariepinus* (Vivien et al., 1986).

*Clarias gariepinus* which is generally considered to be one of the most important tropical catfish species for aquaculture, has an almost pan – African distribution, ranging from the Nile to the west Africa and from Algeria to southern Africa. They also occur in Asia Minor (isreal, Syria, and south of Turkey). By contrast, *Clarias gariepinus* has a more restricted distribution and found in Mauritania, in most west African basins, and in the Nile. In general, *Clarias gariepinus* live in most river basins sympatrically with *Clarias angularis*. (Degreet and janssen, 1996). Also, according to Bard et al., (1976), the genus *Clarias* is widespread in Africa and south east and it's utilization for fish culture purposes has significantly increase during the last few years.

### 2.2 THE BIOLOGY OF CLARIAS GARIEPINUS

#### Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Actinopterigii
Order	:	Siluriformes
Family	:	Claridae
Genus	:	<i>Clarias</i>
Species	:	<i>C. gariepinus</i>

The family *claridae* is divided into two genera – *Clarias* and *Heterobranchus* – each having three species. The former, has single rayed dorsal extending almost to the tail; the later has a long tong

– based, rayed dorsal and an adipose dorsal fin (Reed et al., 1967).

Although more than 100 different species of the genus *Clarias* have been described in Africa, a recent systematic revision based on morphological, anatomical, and biological studies has been carried out by Tengels (1982a,1982b,1984), who recognized 32 valid species. The large African species which are of interest for aquaculture belong to the subgenus *Clarias*.

In earlier systematic studies on the larger African catfish species, Bouleuger (1911) as well as David (1935) recognized five (5) species within the subgenus. Both authors used morphological criteria such as form of vomerine teeth, ratio of vomerine to premaxillary teeth band and the number of gill rakers. The five species are

*Clarias anguillaris*  
*Clarias senegalensis*  
*Clarias mossambicus*  
*Clarias lazera* and  
*Clarias gariepinus*

In 1982, Teugels revised the subgenus *clarias* and found only two species (*C.gariepinus* and *C. angularis*). If the number of gill arch was considered; for *C. anguillaris* relatively high to (20 to 100).

According to Holden and Reed (1972) species of *clarias* are not easily identified because they all look very similar. Each individual must be examined in same detail, and even for trained fisheries biologist. However, three species of *Clarias* have been described from west Africa - *Clarias anguillaris*, *Clarias submerginattus* and *Clarias lazera*. *Clarias anguillaris* ; D66 – 77, A52 HAS 12 (in juveniles ) to 28 gill rakers on the lower arm of the first gill arch. *Clarias submaeginatus* , D82 -88, A66 – 72, has only 8 – 9 gill rakers. *Clarias lazera*, D62 – 82, A50 – 65, has 35 (in juveniles) to 135 gill rakers.

Reed et al., (1967) mentioned the three species as *C. lazera*, *C. anguillaris*, and *C. submerginatus*. *C. lazera* has the pelvic fins midway between the tips of the snout and the root of the caudal fin, or slightly near the snout and the root of the caudal fin, or slightly near the snout. The head is long and body is 3.0 to 3.5 times as long as the head. The colour varies considerably, but is usually blackish on the dorsal side, and white or slightly yellowish on the ventral side. The flanks are grayish olive. The fins are black, except for the ventrals and pectorals which are almost grey or transparent. *C. anguillaris* has the pelvic fins nearer to the tips of the snout than they are to the root of the caudal fin. The head is long and the body 3.1 to 3.8 times as long as the head. The colour is variable but is usually dark

grey on the sides, almost black on the dorsal side, and whitish on the small black spots in an irregular pattern but this is more marked in young and medium – sized specimens.

*C. submarginatus* can be easily separated from the other two species, by the 3 crescent shaped bands on the caudal fin, the outer two dark bands are separated by a lighter on the ventral side. The head is short and it's length can contain 4.4 to 4.8 time in the length of the body.

### 2.3 STRUCTURE

Clarias or mudfish as they are appropriately named have been long bodies with dorsally – flattened head enclosed by bone plates. They have large terminal mouth and four pairs of simple barbells (nasal, maxillary, outer mandibular). The barbells serve as tentacles. Close to the nasal barbells, two olfactory organs are located. Catfish recognizes its prey mainly by touch and smell using its barbells. This is relevant during feeding at night and in highly turbid waters (Reed et al., 1967). The name catfish arise from the barbells found around the mouth for they resemble the whiskers of a cat. These barbells are the most noticeable feature of the family. The nostrils are far apart, the anterior one tabular and the posterior one equipped with a long tentacle. Both dorsal and anal fins are very long, almost reaching to the caudal fin which is a single rounded lobe. Each of the pectoral fins have a spine. The pelvic fins are midway between the tip of the snout and root of the caudal fin, or slightly nearer to the snout. The dorsal fins has 62 – 82 and the anal fins has 50 – 65 rays (Holden and Reed, 1972, and Reed et al., 1967). The vomerine teeth are all mostly granular, forming a band which is 1.3-2.5 times the width of the band teeth on the premaxillary. There are 31 (in juveniles) to 135 long and fine gill rakers on the whole of the of the first gill arch. It has accessory air-breathing organs on the head and can survive for many hours out of water provided the condition is moist. It is fond of 'walking' from water during the rains or when the condition in the water are bad. It can also jump (Marioghae, 1991). According to Reed et al., 1967, viveen et al., 1986, Degraaf and janssen, 1996, the body is covered with a smooth scale less, slimy skin. The skin is generally darkly pigmented on the dorsal and lateral part of the body. The colour is uniformly marbled and changes from grayish olive to blackish according to the substrate of its habitat and on exposure to light, the skin colour becomes lighter. During stress they show a mosaic-like pattern of light and dark spots. The colour varies considerably, but usually blackish on the back and white or slightly yellowish on the belly and the flanks are grayish olive. The fins are black except for the ventral and pectorals which are almost grey or transparent. The

barbells are generally black. *Clarias gariepinus* grows to a maximum total length of 1m or more, and a weight of 7.0kg (marioghae, 1991)

### 2.4 SEXUAL DIMORPHISM IN CLARIAS GARIEPINUS

In most cases the sex of a fish cannot be determined from external characters and it becomes necessary to observe or examine the internal organs. In a few instances there are differences in the shapes of the anal fin of the males and females. In some families like the *claridae*, only the males usually have genital papilla (Reed et al., 1967.) color differences between males and female is sometime apparent, particularly during breeding activities. This is specially marked in cichlids. According to Vivien et al., (1986), in both sexes of *C. gariepinus* the primogenital opening is situated at a papilla just behind the anus. The adult male can be distinguished from the female by the elongated backward projecting form of this papilla. In female the papilla takes the form of oval eminence. Ripe females may also add edges to their median fin (Degraaf and Janseen, 1996). Bruton (1979a) observed 540mm and 580mm for model size of breeding females and males respectively.

### 2.5 NATURAL FOOD AND FEEDING

*Clarias gariepinus* is a slow – moving omnivore predatory fish which feeds on a variety of food items from microscopic zooplanktons to fish half its length or 10% of its own body weight. In order to feed on this wide variety of food organisms in different situations, *C. gariepinus* is equipped with a wide array of anatomical adaptations for feeding under low visibility (Bruton, 1979b) including:

A wide mouth capable of considerable vertical displacement for engulfing large prey or large volumes of water during filter feeding.

A broad band of recurved teeth on the jaws and pharyngeal teeth preventing prey from escaping. An abundant network of sensory organs on the body, head, lips and circumpolar barbells. These barbells are extensively used for prey detection and fixation.

Hecht and Applebaum (1988) found that *C. gariepinus* with barbells are 27% more efficient at catching prey than those without. This indicates that tactile behavior is important in the prey – catching process.

A wide, rounded caudal fin, typical of fish which ambush their prey.

#### Long gill rakers on the five bronchial arches.

A short and dilatable esophagus which opens into a distinct muscular stomach (Mechanical digestion), and a simple thin – walled intestine. Slow searching is the normal predatory tactic of *C. gariepinus* grasping their prey by suction ; a negative suction pressures being created by a sudden increase

of the buccopharyngeal chamber *C gariepinus* has the ability to switch feeding from one type of prey to another. In lake sibaya (South Africa), catfish ignore (or cannot catch) fish prey during daylight and feeding mainly on invertebrates, which are abundant and relatively more easy to catch. By contrast at night, when fish prey become more vulnerable, they switch their feeding habits to fish preys (Bruton, 1979b)

## 2.6 NATUTAL REPRODUCTION.

*Clarias gariepinus* show a seasonal gonadal maturation which is usually associated with the rainy season. The maturation process of *C gariepinus* is influenced by annual change in water temperature and photo periodicity, and the final triggering of spawning is caused by a rise in the water level due to rainfall (Degraaf et al., 1995). Spawning usually take place at night in the shallow inundated areas of rivers, lakes and streams. Courtship is usually preceded by "highly aggressive" encounters between males. Courtship and mating take place in shallow water between isolated pairs of males and females. The mating posture, a form of amplexus (the male lie in a unshaped curve around the head of the females) is held for several seconds.

During courtship which can last several hours the females catfish lays her eggs in several batches, the partner fertilizes the egg at the same time each batch of eggs by releasing a cloud of sperm on the eggs. Within some seconds, the females distributes the fertilized eggs over a wind are by wiping them with her tail. The eggs will finally adhere to the flood vegetation. After spawning the shoal of catfish migrate back into deeper water. There is on parental care of the eggs. After a few weeks, the African catfish will often have developed a new batch of eggs and is prepared to spawn again. A second spawning can be induced by rainfall or by inflow of water from an upstream source. In this way, several spawning can take place per year. Depending on water temperature, the eggs will hatch after 24- 36 hours. The so called yolk sac larvae hid underneath the vegetation. The development of eggs and larvae is rapid and the larvae are capable of swimming within 48 0 72 hours after fertilization. Probably, due to high mortality rates among the eggs and fingerlings in nature, fry and fingerling of catfish are difficult to find. Therefore, egg and fry rearing in hatcheries remains the only available option for fish culturists.

## 2.7 WATER QUALITY PARAMETERS.

Water quality parameter includes all physical, chemical and biological factors that influence the beneficial use of water. In fish cultures, any characteristics of water that affects the growth, survival reproduction, production, or management of fish in any way is referred to as a

water quality variable. For the achievement of optimum fish production the water quality of the medium is of great importance. It is not only necessary to ensure that a proper range of these environmental factors (biotic and biotic) is maintained, but also that they properly managed and regulated on a continuous basis so that they are within a desirable range for fish growth and survival (Omaha, 1991).

There are many water quality variables in fish pond culture. All other being equal, a pond with good water quality will produce more and wealthier fish than a pond quality. Water quality determines to great extent the success or failure of a fish cultural operation (piper et al., 1982). Water quality parameters which are of prime importance are mainly temperature, turbidity, oxygen, carbon di oxide, nitrogen, ammonia, pH, alkalinity, hardness, etc.

### 2.7.1 Temperature

This is considered as one of the most important factor in aquatic environment because it affects all metabolic, physiological, activities and life processes of different trophic level of pond ecosystem. In addition, it also affect the speed of chemical change in soil and water (Dhirendea,2002).water temperatures plays an important role in influencing the periodicity, occurrence and abundances of phytoplankton as it had a direct relationship with total plankton (Tripathi and Pandey, 1990). The optimum temperature range for "cold warm water" and "warm water" fishes are 14 – 18° c and 24 – 30°c respectively. The maintenance of this ranges of temperature is of great importance because the body temperatures of the fish varies with and almost the same as that of the environment (Onuha and Nwudukwe, 1987 ; Durpree and Huner, 1984). 5° sudden change in temperature may stress or kill the fish

### 2.7.2 Turbidity

This term refers to the suspended solids particles, plank tonic organisms and humic substances produced through decomposition of organic matter. In aquaculture ponds, turbidity from plank tonic organism are often desirable to an extent where as that caused by suspended particles is undesirables (Mc combie, 1953). However, heavy blooms limit heat and light penetration, than reducing the productive zone. Optimum secchi-disc visibility of fish pond is considerably to be 30 - 40cm. in pond with secchi – disc visibility of 10 – 20cm dissolved oxygen concentration may fall so low at night that fish are stressed or even killed (Romaine and Boyd, 1978).

### 2.7.3 Dissolved Oxygen



Chakroff (1978) stated that fish like all animal need oxygen to survive. In the absence of deliberate poisoning, dissolved oxygen is the single most important water quality parameter in pond culture systems. Fish differ in their sensitivity to low oxygen between species, the various life stages (eggs, larvae and adults) and the different life processes such as feeding, growth and reproduction. It was observed that dissolved oxygen content of pond water in the range of 5mg/litre to saturation level favour fish culture (Ovie and Adeniji, 1990). The concentration of dissolved oxygen in natural water is influenced by the rates of diffusion to and from the atmosphere, photosynthesis by aquatic plants and respiration by aquatic biological community.

#### 2.7.4 Carbon oxide

The primary sources of CO<sub>2</sub> in fish pond are derived from respiration by fish and the microscopic plants and animal that comprises the fish pond biota. The problem with the potential toxicity of CO<sub>2</sub> can be related to the daily fluctuating patterns of dissolved oxygen and CO<sub>2</sub> concentrations. CO<sub>2</sub> concentrations are highest when dissolved oxygen concentrations are lowest. Fresh water fish pond should contain a low concentrations of free CO<sub>2</sub> (<3mg/liter), although it can tolerate high concentrations of CO<sub>2</sub> (Boyd, 1978). Experiment has shown that 1.0mg/liter of hydrated lime can remove 1.68mg / liter of free CO<sub>2</sub> (Adhikari, 2006)

#### 2.7.5 Ammonia

Fish are very sensitive to unionized ammonia and the optimum range is 0.02 – 0.05mg/litre in the pond water. When ammonia accumulated to toxic levels, fish cannot extract energy from feed efficiently. If the ammonia concentration get high enough, the fish will become lethargic and eventually fall into a coma and die. However ammonia can have a so called “sub-lethal” effects such as reduced growth, poor feed conversion, and reduced disease resistance at concentration that at lower than lethal concentrations. Sources of ammonia in fish ponds include fish excretion, protein in feeds, and diffusion from sediments (Cole and Boyd, 1986).

#### 2.7.6 Hydrogen sulphide

Fish lose their equilibrium and subjected to sub lethal stress at concentration of 0.01mg / liter of hydrogen sulphide. Frequent exchange of water can prevent building up of hydrogen sulphide. Further increasing water pH through liming can also reduce the hydrogen sulphide toxicity.

#### 2.7.7 pH

pH is the measure of hydrogen ion concentration in water (Chakroff, 1978). pH ranges

from 0 – 14. A pH value between 0 and 7 is termed acidic, while pH values above 7 are termed basic. A pH value of 7.0 indicates neutral solution. pH has direct effect on fish growth and survival of food organisms. Hence to achieve good fish production pH of the water should be maintained at an optimum range of 6.7 to 8.6 (Ovie and Adeniji 1990). While Chakroff (1979) stated that fish grow best in pH 6.5 to 9.0. It also exerts considerable influence on toxicity of ammonia and hydrogen sulphide as well as solubility of nutrients and thereby water fertility. Charkroff (1978) also stated that fish are sensitive to acidic water and therefore will die if the pH of pond water falls below 4 for a very long period of time.

#### 2.7.8 Alkalinity

This is the capacity of water to neutralize acids without an increase in pH. Total alkalinity is the sum of the carbonate and bicarbonates alkalinities. The carbonate buffering system is important to fish growth regardless of production method used. Without a buffering system, free carbon dioxide will form large amount of weak acid (carbonic acid) that may potentially decrease the night time pH level to 4.5 pond water with low alkalinity <20mg / liter CaCO<sub>3</sub> and >300mg / liter is unproductive. The ideal range of total alkalinity for fresh water fish pond is 50 – 300mg / liter as CaCO<sub>3</sub>.

#### 2.7.9 Conductivity

This refers to the total concentration of all dissolved ions in the natural water which is expressed in micro – ohms per centimeter. Fish are very sensitive to sudden changes in conductivity. Fish living in water at one concentration of conductivity should not be suddenly placed in water with a much higher or lower conductivity. Small fish and fry of most species are more susceptible than adult fish to sudden change in conductivity.

#### 2.8.0 Hardness

This is the measure of calcium and magnesium, but other such as aluminum, iron, manganese, strontium, zinc, and hydrogen ions are covered. Calcium and magnesium are essential in the biological processes of fish. Fish can absorb calcium, magnesium directly from the water or food. Hardness values of at least 30mg / liter should be maintained for optimum growth of aquatic organisms. Charkroff (1978) stated that hardness should be between 50 and 300 ppm in the pond for best fish growth. Water that contains few salts is called “soft” water. Hardness is related to pH, but unlike pH, hardness stays constant throughout the day.

**Table 1:** Optimum water quality requirements for a fish pond.

S/No	Parameters	Optimum Level	S/No.	Parameter	Optimum
1.	Colour (colour unit)	Clear water < 100 colour unit	7.	Alkalinity (mg / l)	50 – 300
2.	Transparency (cm)	30 – 40	8.	Chloride (mg / l)	31 -50
3.	Clay turbidity (mg / l)	< 30	9.	Salinity (ppt)	5 -10
4.	Solids (mg / l) (a) Total (b) Suspended	< 500 30 - 200	10.	Dissolved oxygen (mg / l)	5 – 10
5.	Temperature (°c) (a) Warm water (b) Cold water	25 – 32 10 – 12	11.	Total dissolved co <sub>2</sub>	<3
6.	pH	6.5 -8.5	12.	Ammonia nitrogen (mg/l) Ionized Unionized	0 -0.1 0 -1.0
13.	Hardness(mg / l)	30 – 180			
14.	Nitrite nitrogen (mg/l)	0 – 0.5	20.	Nitrite nitrogen (mg/l)	0.1 – 3.0
15.	Total nitrogen (mg/l)	0.5-4.5	21.	Total phosphorus (mg/l)	0.05– 0.5
16.	Potassium (mg/l)	0.5-10	22.	Calcium (mg/l)	75 - 150
17.	Silica (mg/l)	4 – 16	23.	B.O.D. (mg/l)	<10
18.	C.O.D. (mg/l)	<25	24.	Iron (mg/l)	0.01–0.30
19.	Hydrogen sulphide (mg/l)	<0.002	25.	Residual chlorine (mg/l)	<0.003

Source: Pronob Das et al., (2011). Management of Water Quality in Fish Ponds.

### 2.8.1 STREAM, BOREHOLE, AND TAP WATERS

‘Soft’ or ‘hard’ water relates to the percentage of dissolved minerals in the water. Rain water is naturally soft and contains very little dissolved matter. But as it seeps through the ground, it picks up various minerals from the soil and rock as it pass through. Hard water is often found associated with chalk and limestone areas. Soft waters are associated to impermeable rocks such as granite. In general, surface waters such as streams are often softer than ground waters such as borehole as there has been less contact with the minerals present in the earth (Zagorodni, 2006).

The higher concentration of various metals present in borehole water (e.g. Iron, Cadmium, Zinc, Aluminum, and Boron) also accounts for its hardness, and usually causes increased pH. Soft waters like tap exhibit stronger tendency towards instability than hard waters (Excell et al., 1988). This means that all aquaria becomes more acidic over time due to nitrification, respiration, and photosynthesis. But in soft water aquaria, this trend can be very rapid. Since few fishes tolerate rapid change in pH, frequent pH tests becomes necessary. The carbonates and bicarbonates present in hard waters balances the drop in pH. But soft waters lack these minerals and thus are liable to rapid pH changes which fish don't like because it cause them to adjust body chemistry of their blood to prevent physiological problems and stress conditions.

Fish live in intimate contact with its environment which is the source of both water and

ions (Adey and Loveland, 1991). The main site of intimate contact is the gills. Underneath the gill are chloride cells which are sensitive to a stress hormone called “cortisol”. The response to stress is not aimed at the cardiovascular system, but the hydromineral balance and energy metabolism. This can lead to reduced growth and lower immune system.

### 3.0 MATERIALS AND METHOD

An eight week long experiment to study the survival and growth rate of *clarias gariepinus* under different medium namely tap, borehole, and stream waters. This was conducted in the biotechnology unit of the department of biological sciences located in the southwest corner of the mini campus, University of Abuja, FCT.

#### 3.1 AQUARIA AND TREATMENTS

Thirty six mixed sexes of *clarias gariepinus* fingerlings of eight weeks old, were obtained and transported from a fish farm in a container with oxygenated water at 5pm – 6pm to avoid mortality due to high stress. The fingerlings were acclimatize for seven days while being fed with 3mm Coppens fish fed a 4% net body weight with an average weight and length of 10 + 2g. Water levels maintained at 35cm (25 liters), and twelve fingerlings were stocked in each tanks labeled as follows A (tap), B( borehole) and C (stream water) respectively. Treatment A is labeled as the treatment control. Stream water was sieved through a mesh net to remove sediments and suspended particles present in it. Mosquito nets were used to prevent fingerlings from jumping out, intrusion of insects and other foreign bodies e.g. lizards, geckos, etc. Water samples are renewed at

two days intervals. Where the tanks are cleaned by scrubbing, siphoning accumulated food particles, and disinfecting using 3ml/L potassium permanganate afterwards they are rinsed with clean water.

### 3.2 FEEDING AND MEASUREMENT

The treatments, were fed with 3mm Coppens fish feed at 4% body weight daily twice daily between 6 to 8 am and 4 to 6pm.

**Table 2:** Analytical components of Coppens fish feed

Major components	% composition
Crude protein	45
Crude fat	12
Crude fiber	1.5
Ash	9.5
Phosphorus	1.2
Calcium	1.7
Sodium	0.4
Trace elements	Amount (mg/kg)
Iron	75.0
Iodine	5.0
Cobalt	1.0
Copper	5.0
Manganese	20.0
Zinc	80.0
Selenium	1.3
Additives	Amount
Vitamin A	10,000 IU/kg
Vitamin D <sub>3</sub>	2,000 IU/kg
Vitamin E	200 mg/kg
Vitamin C	150 mg/kg

Mortality is daily monitored, while growth rates are calculated weekly by measuring their weight and length. Using an automated top loading balance (model : Ohaus precision plus), and a plastic ruler stretched between the snout and tail of the fish.

### 3.3 PHYSIOCHEMICAL PARAMETERS

The physiochemical parameters were monitored daily for the first week of the experiment to determine the maximum duration at which water quality reached its lethal level includes water and air temperature. An interval of two days was found to be appropriate for water renewal.

Equipments used were laboratory glass thermometer; a pH meter ( PHS-3C), conductivity using conductivity meter; dissolved oxygen using an oxygen meter, ammonia and nitrite using the urinalysis test strip kit.

### 3.4 FOOD UTILIZATION PARAMETER

#### 3.4.1 Specific growth rate (SGR)

This was calculated from using body weight over a given period of time intervals according to the method of Brown (1957).

$$SGR(\%) = \frac{\log W_2 - \log W_1 \times 100}{T-t}$$

Where W1 = initial weight (in grams) at time t, W2 = final weight (in grams) at time T, T = final time (in days), t = initial time (in days).

#### 3.4.2 Mean growth rate (MGR)

This was computed using the standard equation;

$$MGR = \frac{W_2 - W_1 \times 100}{0.5 (W_1 + W_2) \times t}$$

Where, W1 = initial weight (in grams), W2 = final weight (in grams), t = period of experiment (in days)

#### 3.4.3 Food conversion efficiency (FCE).

This was computed using the equation;

$$FCE (\%) = \frac{\text{Weight gain}}{\text{Food in take}} \times 100$$

#### 3.4.4 Percentage weight gain

This is expressed by the equation;

$$\% \text{ WG} = \frac{W_t - W_0}{W_0} \times 100$$

Where  $W_t$  = Weight at time t,  $W_0$  = Initial weight.

### 3.4.5 Weight gain

This was calculated as the difference between the initial and final mean weight values.

### 3.4.6 Survival rate

This was calculated as the total number of fish harvested divided by total number of fish stocked

at the initial time. Survival rate is expressed in percentage.

$$\text{S.R.(\%)} = \frac{\text{Total fish number harvested}}{\text{Total fish number stocked}} \times 100$$

### 3.4.7 STATISTICAL ANALYSIS

Analysis of growth data using a one way analysis of variance (ANOVA).

## 4.0 RESULTS.

Table 3: Production Parameters for Treatment A (Tap water).

Production Parameters	WEEKS								
	0	1	2	3	4	5	6	7	8
Gross weight (g)	145.13	164.75	195.36	241.36	294.28	338.16	395.22	457.56	537.96
Mean weight (g)	12.09	13.73	16.28	20.11	24.52	28.18	32.94	38.13	44.83
Weight gain (g)	0.00	1.64	2.55	3.83	4.41	3.66	4.76	5.19	6.70
Total length (cm)	143.40	148.60	159.40	169.60	187.10	193.36	207.30	219.00	237.12
Mean length (cm)	11.95	12.38	13.28	14.13	15.59	16.11	17.28	18.25	19.76
Length gain (cm)	0.00	0.43	0.90	0.85	1.46	0.52	1.17	0.97	1.51
Specific growth rate (%)	0.00	0.789	0.528	0.437	0.08	0.173	0.161	0.130	0.126
Mean growth rate (%)	0.00	0.282	0.304	0.314	0.300	0.270	0.249	0.231	0.216
Food conversion eff./ (%)	0.00	28.25	38.70	49.01	45.68	31.09	35.19	32.83	36.61
Survival rate (%)	100	100	100	100	100	100	100	100	100

Table 4: Production Parameters for Treatment B (Borehole water).

Production Parameters	WEEKS								
	0	1	2	3	4	5	6	7	8
Gross weight (g)	130.36	126.88	146.50	153.77	192.31	225.0	224.91	215.84	231.36
Mean weight (g)	10.80	11.54	13.32	15.38	19.23	22.50	24.99	26.98	28.92
Weight gain (g)	0.00	0.74	1.78	2.06	3.85	3.27	2.49	1.99	1.94
Total length (cm)	131.75	130.21	138.90	131.80	141.40	149.80	142.29	133.44	140.40
Mean length (cm)	10.90	11.84	12.63	13.18	14.14	14.98	15.81	16.68	17.55
Length gain (cm)	0.00	0.94	0.79	0.55	0.96	0.84	0.83	1.50	0.87
Specific growth rate (%)	0.00	0.411	0.445	0.297	0.347	0.195	0.109	0.068	0.030
Mean growth rate (%)	0.00	0.170	0.250	0.263	0.290	0.275	0.250	0.227	0.207
Food conversion eff.	0.00	14.19	35.07	35.15	62.59	42.51	27.67	22.12	22.47
Survival rate (%)	100	91.67	91.67	83.33	83.33	83.33	75.0	66.67	66.67

Table 5: Production Parameters for Treatment C (Stream water).

Production Parameters	WEEKS								
	0	1	2	3	4	5	6	7	8
Gross weight (g)	129.98	141.05	141.05	178.02	211.31	241.32	244.76	237.60	254.60
Mean weight (g)	10.83	11.75	12.37	14.84	17.61	20.11	22.26	23.76	25.46
Weight gain (g)	0.00	0.92	0.62	2.47	2.77	2.50	2.15	1.50	1.70
Total length (cm)	129.96	140.90	146.50	159.50	163.40	167.76	158.29	148.80	155.50
Mean length (cm)	10.87	11.74	12.21	13.29	13.62	13.98	14.39	14.88	15.55
Length gain (cm)	0.00	0.87	0.47	1.08	0.33	0.36	0.41	0.49	0.67
Specific growth rate (%)	0.00	0.505	0.160	0.377	0.266	0.165	0.105	0.058	0.054
Mean growth rate (%)	0.00	0.207	0.164	0.238	0.254	0.244	0.226	0.205	0.190
Food conversion eff.	0.00	17.70	11.00	41.60	38.90	29.58	22.27	15.32	17.89
Survival rate (%)	100	100	100	100	100	100	91.67	83.33	83.33

Table 6: Physiochemical Parameters for Treatment A (Tap water) (Weekly Mean Values)

Physiochemical Parameter	WEEKS							
	1	2	3	4	5	6	7	8
Atmospheric temperature (°C)	27.6	27.9	28.5	29.2	28.5	27.8	26.6	27.5
Water temperature (°C)	24.9	25.3	26.1	26.4	25.3	24.7	23.8	24.1
pH	7.3	7.9	7.8	8.1	8.3	8.5	8.6	8.4
Dissolved Oxygen (mg/l)	6.80	6.12	5.31	5.05	4.81	4.56	4.06	3.89
Conductivity (micro/ohms/cm)	23.0	26.7	21.8	25.7	23.0	25.9	23.8	26.1
Ammonia (mg/l)	0.01	0.43	0.55	0.68	1.03	1.42	1.83	2.11
Nitrite (mg/l)	0.001	0.02	0.02	0.03	0.04	0.04	0.05	0.06

Table 7: Physiochemical Parameters for Treatment B (Borehole water) (Weekly Mean Values)

Physiochemical Parameter	WEEKS							
	1	2	3	4	5	6	7	8
Atmospheric temperature (°C)	27.6	27.9	28.5	29.2	28.5	27.8	26.6	27.5
Water temperature (°C)	24.9	25.2	26.2	26.4	25.3	24.6	23.8	24.1
pH	7.4	7.8	7.8	7.9	8.1	8.3	8.5	8.4
Dissolved Oxygen (mg/l)	6.52	6.19	6.03	5.81	4.96	4.47	4.19	3.98
Conductivity (micro ohms/cm)	19.3	25.5	28.0	29.5	28.1	27.4	28.2	29.8
Ammonia (mg/l)	0.01	0.39	0.44	0.58	0.74	0.82	0.90	1.41
Nitrite (mg/l)	0.001	0.01	0.02	0.02	0.03	0.04	0.05	0.05

Table 8: Physiochemical Parameters for Treatment C (Stream water) (Weekly Mean Values)

Physiochemical Parameter	WEEKS							
	1	2	3	4	5	6	7	8
Atmospheric temperature (°C)	27.6	27.9	28.5	29.2	28.5	27.8	26.6	27.5
Water temperature (°C)	24.8	25.4	26.3	26.6	25.7	26.4	24.0	24.3
pH	7.4	7.6	7.8	8.1	8.3	8.4	8.7	8.6
Dissolved Oxygen (mg/l)	6.83	6.62	6.40	6.15	5.86	5.57	5.28	4.95
Conductivity (micro olms/cm)	23.5	27.0	25.6	26.0	24.2	28.0	24.7	28.2
Ammonia (mg/l)	0.01	0.25	0.31	0.36	0.40	0.49	0.55	1.58
Nitrite (mg/l)	0.001	0.01	0.01	0.02	0.02	0.03	0.04	0.05

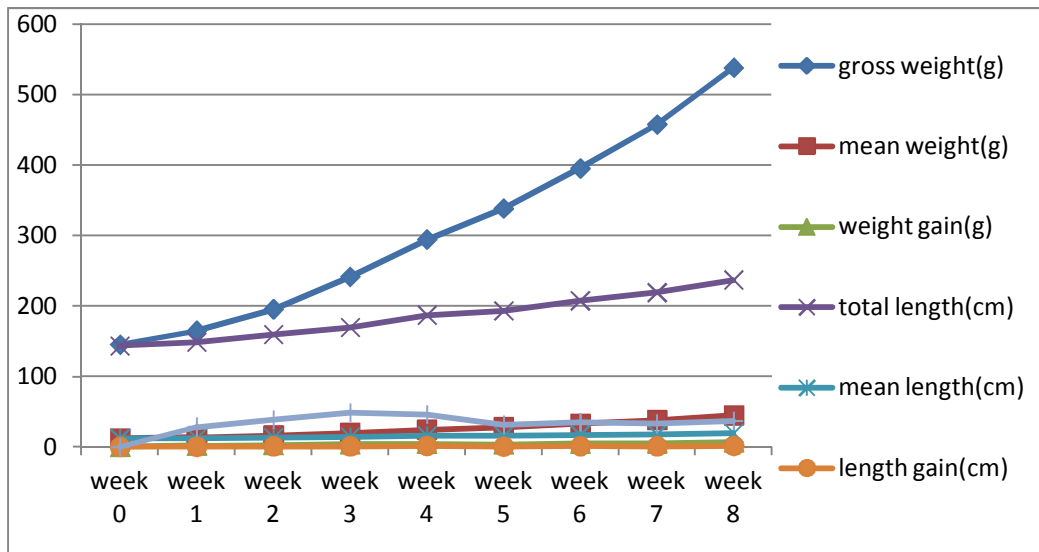


Figure 1: Production parameters for treatment A (Tap water).

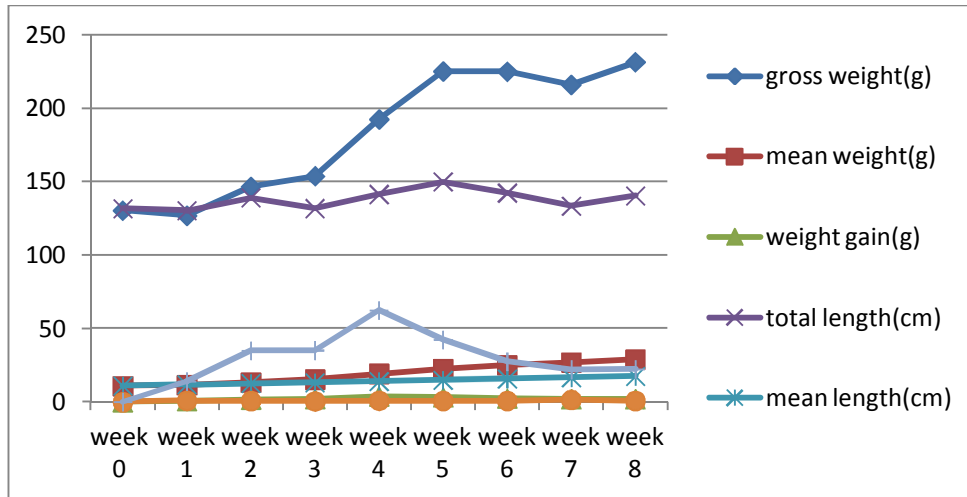


Figure 2: Production parameters for treatment B (Borehole water)

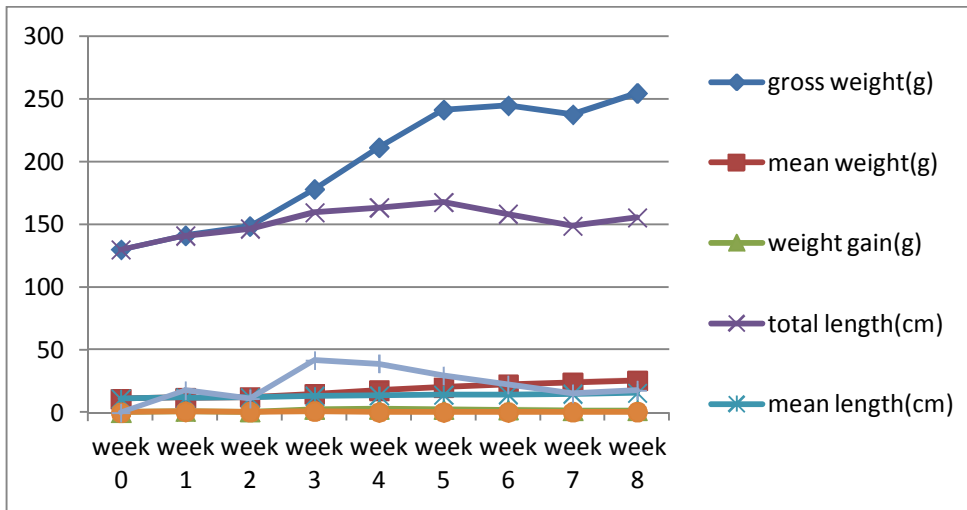


Figure 3: Production parameters for treatment C (Stream water)

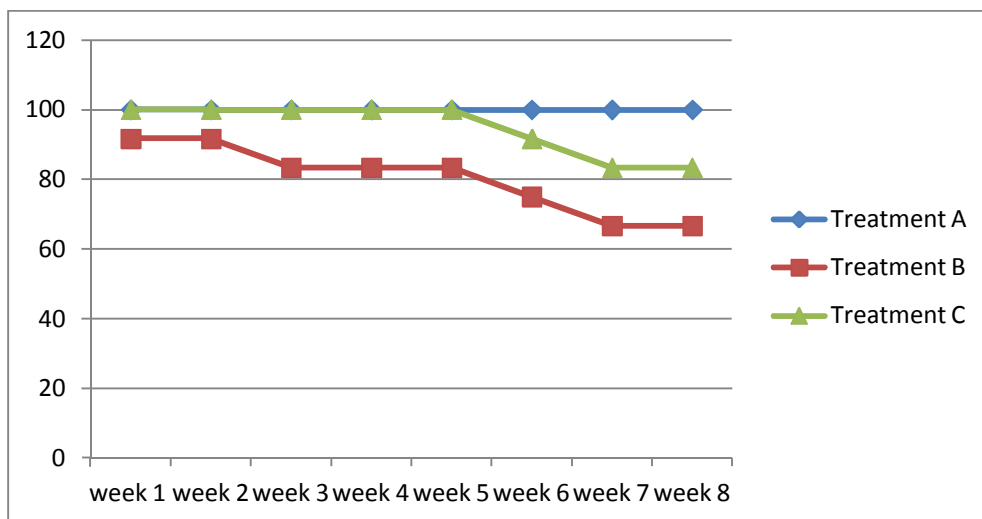


Figure 4: Survival rates (%) for treatments A,B and C.

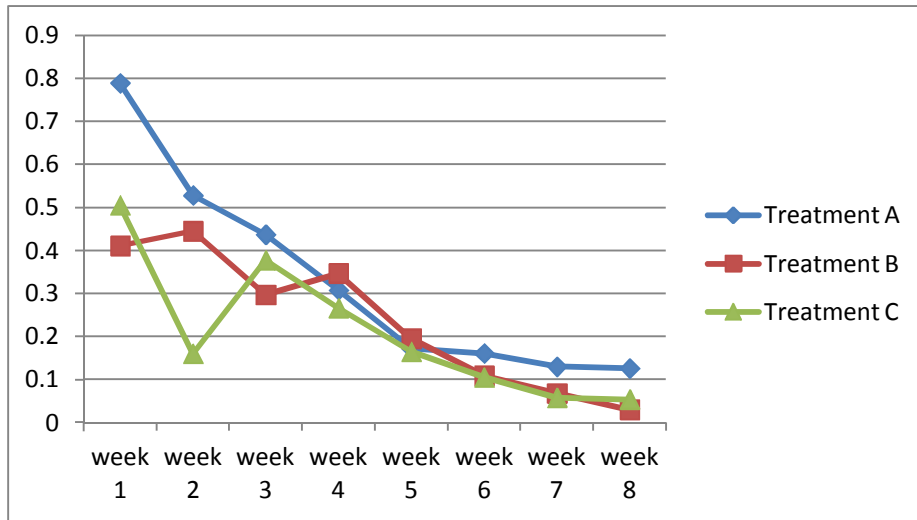


Figure 5: Specific growth rates (%) for treatments A, B and C.

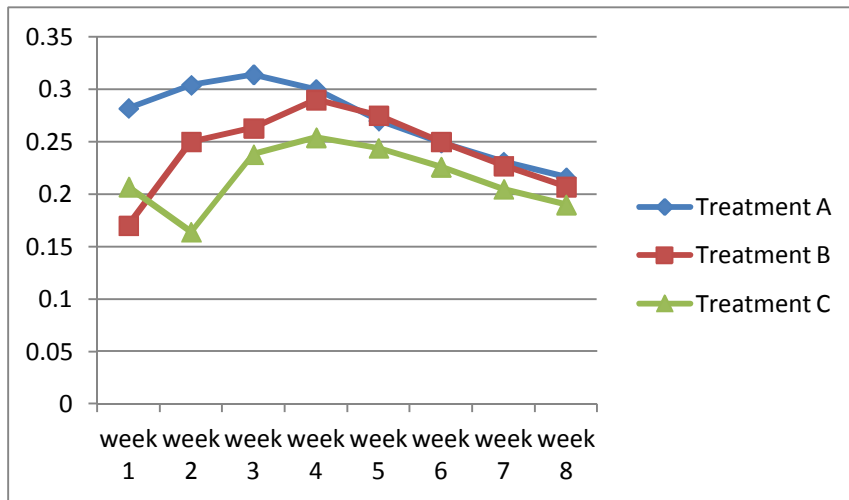


Figure 6: Mean growth rate for treatments A, B and C.

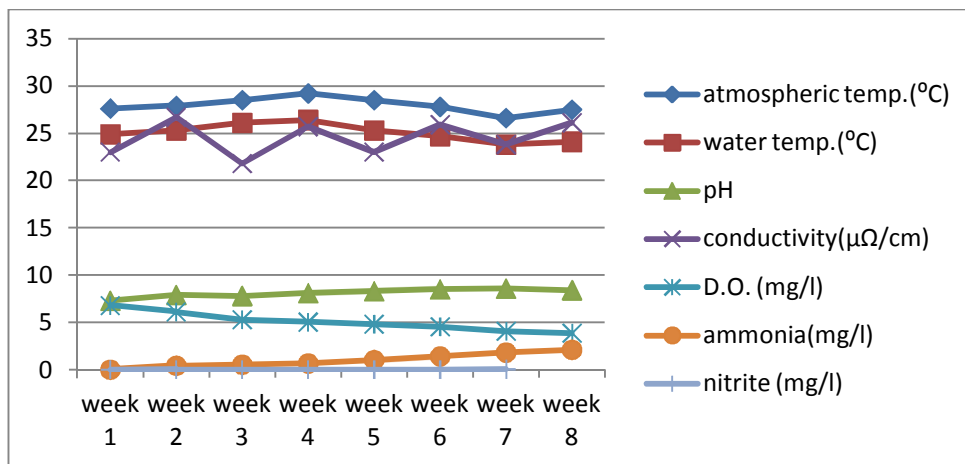


Figure 7: Physiochemical parameters for treatment A (Tap water).

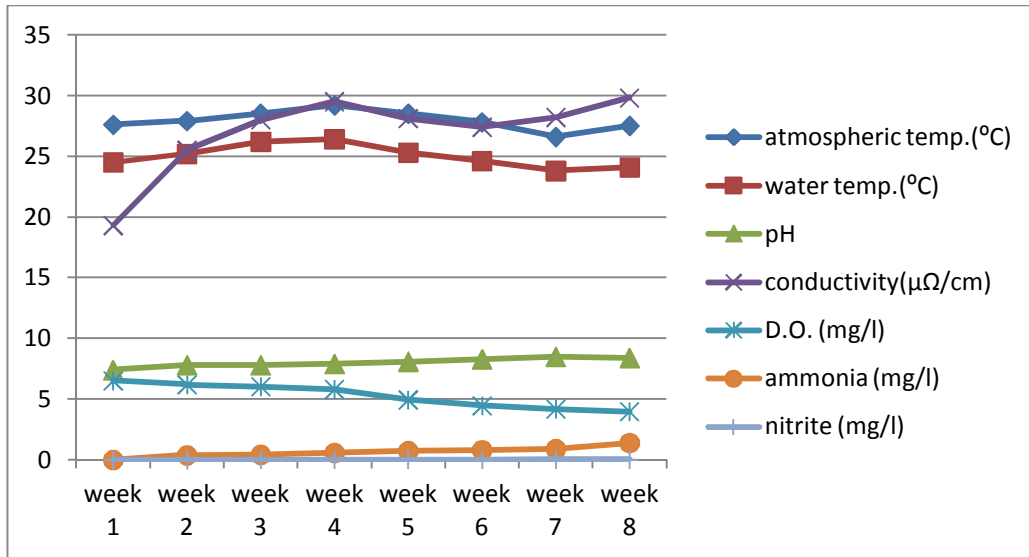


Figure 8: Physiochemical parameters for treatment B (Borehole water)

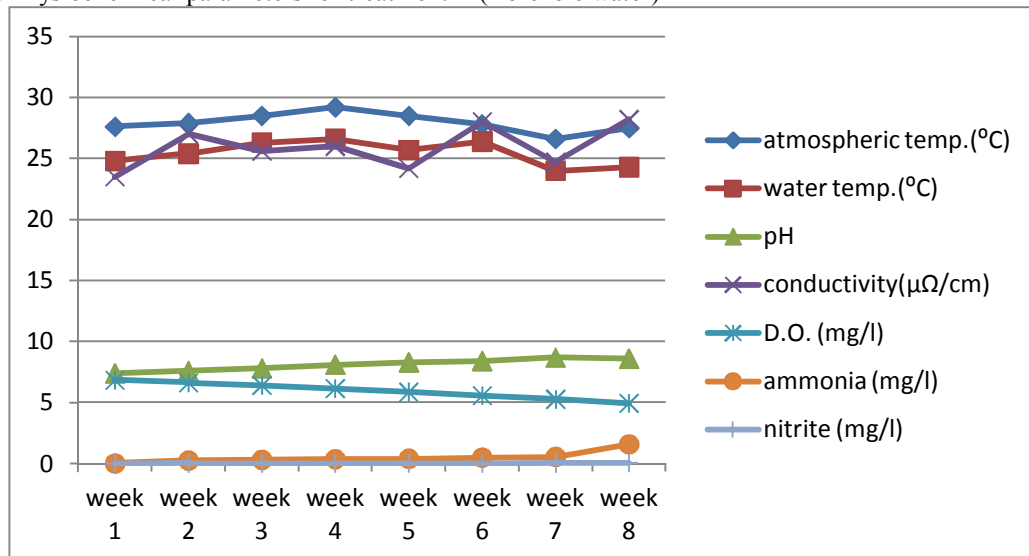


Figure 9: Physiochemical parameters for treatment C (Stream water).

#### 4.1 Analysis

Adverse concentration of water quality parameters especially dissolved oxygen and unionized ammonia were noticeable and serves as the cause of mortality.

Both water and air temperatures recorded during the experimental period were within tolerable range (26.6°C to 29.2°C) for the culture of warm water fish as recommended by (Onuoha and Nwadukwe, 1987). (Table 6, 7, and 8) and (Figure 7, 8, and 9) for all treatments.

The pH value varied from 7.3-8.4, 7.4-8.4, and 7.4-8.5 for treatments A, B, and C, which indicates alkaline and were within tolerable range of 6.5 to 9.0 as stated by Chakroff (1979) and 6.7 to 8.6 by Ovie and Adeniji (1990)

Throughout the experimental period, the nitrite level never attained adverse lethal level, which ranged from 0.001 to 0.06, 0.001 to 0.05 and 0.001 to 0.05 for treatments A, B, and C respectively. These values were within the tolerant range of 0.00 to 0.5 as recommended by Pronob Das et al., (2011).

Ammonia exceeded the optimum range towards the end of the experimental period. This progressive rise in the concentration of ammonia with time could be attributed to increase in biomass of the fish. The highest value of 2.11 was recorded in treatment A (0.01 to 2.11), B (0.01 to 1.41) and C (0.01 to 1.58). Dissolved oxygen decreased gradually and progressively with time as biomass (growth). This is mainly due to metabolic activities and decaying organic materials such as underutilized feed. The range of dissolved oxygen recorded



depreciate below the optimum range of 5-10mg/l accordingly to Pronob Das et al (2011). From the 5<sup>th</sup> week treatments A (6.80 to 3.89), and B (6.52 to 3.89,) and in the last week for treatment C. (6.83 to 4.95)

According to Brown (1957), the survival of *Clarias* is not dependent on dissolved oxygen due to its capability of obtaining oxygen by gulping air. While inadequate dissolved oxygen may not in itself be lethal, it may affect seriously the health of the fish and facilitate the spread of disease. Mayer (1970) indicated that the role of low dissolved oxygen levels in promoting bacterial infections is often unsuspected.

Conductivity fluctuated with time in all treatment especially in treatment A which varied from A (21.8 to 26.7), B (19.3 to 29.8), and C (23.5 to 28.2) micro olms per centimeter ( $\mu\Omega/\text{cm}$ ).

Production in all treatments were minimal during the last few weeks and have affected fish performance, as indicated by the decreased slope of production parameters such as mean weight, mean lengths, mean weight gain, mean length gain, and food conversion efficiency. (Table 3, 4, and 5, and Figure 1, 2, and 3). The minimal production experienced during the last few weeks indicated that there was progressive decrease in the specific growth rates and mean growth rates (Figure 5 and 6 respectively). This is a result of the progressive deterioration of such as ammonia, dissolve oxygen, physical, and physiological stresses encountered by the fish during the stressful exchange of water.

The survival rates were A (100%), B (66.67%) and C (83.33%) (Table 3, 4, and 5, and Figure 4). When subjected to a one way analysis of variance (single factor ANOVA), the results showed a significant difference ( $p < 0.05$ ) for the survival rate in all treatments. Mortality occurred during the last few weeks of the experiment especially, for treatment B which recorded the highest value.(66.67%). No mortality was recorded for treatment A (tap water) probably due to variations in its hardness of about 50mg/l which was moderately soft while the other water quality parameters were compared treatment C (stream water), which was richer in dissolved minerals, while treatment B (borehole) was is the hardest (>250mg / l) of all three water type afomentioned. However, the mortality recorded in treatment B, and C may also be attributed mainly to stresses that may have resulted from the weekly sampling which showed that the average weight gain was 3.638g, 2.013g, and 1.626g for treatments A, B, and C respectively while the average length gain was A (0.868cm), B (0.809cm), and C (0.52cm). When subjected to a single factor analysis of variance, a significant difference was observed ( $F = 9.4$ ,  $df = 24$ ,

$P < 0.05$ ), with treatment A having the highest productivity. However, no significant difference was observed in length gain ( $F = 1.879$ ;  $df = 24$ ;  $P > 0.05$ ) among treatments.

Also, no significant difference in mean weights ( $F = 2.328$ ;  $df = 24$ ;  $P > 0.05$ ) and mean total lengths ( $F = 1.905$ ;  $df = 24$ ;  $P > 0.05$ ).The specific growth rates, mean growth rates and food conversion efficiencies showed no significant difference when subjected to single factor analysis of variance i.e. A ( $F = 0.387$ ;  $df = 24$ ;  $P > 0.05$ ), B ( $F = 0.694$ ;  $df = 24$ ;  $P > 0.05$ ) and C, ( $F = 1.322$ ;  $df = 24$ ; 0.285) respectively.

The fact that all other production parameters, apart from the mean weight gain and survival rate showed no significant difference could be attributed to the same type of quantity of feeding; uniform time of feeding and sanitary conditions maintained in all treatments. But the significant difference observed in the mean weight gains and survival rates in all three treatments suggest that treatment A (tap water) produced better fish growth and survival rather than treatments B and C.

## 5.0 CONCLUSION.

*Clarias gariepinus* fingerlings were reared in rectangular plastic aquaria in tap, borehole and stream waters and fed with coppens fish feed twice daily for an experimental period of 60 days. The survival rates were 100% 66.67% and 83.33% for treatment A, B, and C respectively, while the final mean weights were 44.83g (A), 28.92g (B) and 25.46g (C).

The statistical analysis revealed no significant difference ( $P > 0.05$ ) in all production parameters except the mean weight gain and survival rate ( $P < 0.05$ ) thus suggesting that treatment A produced better growth and survival rate than the other two treatments. A significant difference of ( $P > 0.05$ ) revealed that treatment A provided the highest value .Water quality parameters such as Dissolved oxygen and ammonia were minimal, on the whole, the physiochemical parameters were within optimum range for ideal fish production and therefore did not affect growth rate and survival of *Clarias gariepinus* fingerlings . Findings showed that *Clarias gariepinus* fingerlings could be reared in all water mediums , but tap water provided the highest productivity and survival rate for the production of *Clarias gariepinus* fingerlings.

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**LIST OF APPENDICES**

1. One-way Anova: for mean weights						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Mean weight (g)a	9	230.81	25.64556	128.6116		
Mean weight (g)b	9	173.66	19.29556	47.21775		
Mean weight (g)c	9	158.99	17.66556	30.34103		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	319.9794	2	159.9897	2.328021	0.119108	3.402826
Within Groups	1649.363	24	68.72347			
Total	1969.343	26				
2. One-way Anova: for mean weight gains						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Weight gain (g)a	9	32.74	3.637778	4.010944		
Weight gain (g)b	9	18.12	2.013333	1.36465		
Weight gain (g)c	9	14.63	1.625556	0.904403		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	20.514689	2	10.25734	4.900007	0.016426	3.402826
Within Groups	50.239978	24	2.093332			
Total	70.754667	26				
3. One-way Anova: for mean total lengths						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Mean length (cm)a	9	138.73	15.41444	7.291878		
Mean length (cm)b	9	127.71	14.19	5.067625		
Mean length (cm)c	9	120.53	13.39222	2.345244		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	18.67529	2	9.337644	1.905027	0.170653	3.402826

Within Groups	117.638	24	4.901582			
Total	136.3133	26				

4. One-way Anova: for mean length gains						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Length gain (cm)a	9	7.81	0.867778	0.241494		
Length gain (cm)b	9	7.28	0.808889	0.155561		
Length gain (cm)c	9	4.68	0.52	0.100775		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.623622	2	0.311811	1.87902	0.17453	3.402826
Within Groups	3.982644	24	0.165944			
Total	4.606267	26				
5. One-way Anova: for specific growth rates						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Specific growth rate for A (%)	9	2.424	0.269333	0.066805		
Specific growth rate for B (%)	9	1.902	0.211333	0.02863		
Specific growth rate for C (%)	9	1.69	0.187778	0.027587		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.031711	2	0.015855	0.386647	0.683486	3.402826
Within Groups	0.98417	24	0.041007			
Total	1.01588	26				

6. One-way Anova: For mean growth rates						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Mean growth rate for A (%)	9	2.166	0.240667	0.009271		
Mean growth rate for B (%)	9	1.932	0.214667	0.007804		
Mean growth rate for C (%)	9	1.728	0.192	0.005983		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.010675	2	0.005337	0.694393	0.509134	3.402826
Within Groups	0.184472	24	0.007686			
Total	0.195147	26				

7. One-way Anova: for food conversion efficiencies						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Food conversion efficiency for A (%)	9	297.36	33.04	197.831		
Food conversion efficiency for B (%)	9	261.77	29.0856	317.186		
Food conversion efficiency for C (%)	9	194.26	21.5844	176.344		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	609.402	2	304.7011	1.32218	0.28528	3.402826

Within Groups	5530.89	24	230.4536			
Total	6140.29	26				

8. One-way Anova: for survival rates						
SUMMARY						
<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
Survival rate (%) A	9	900	100	0		
Survival rate (%) B	9	741.67	82.40778	129.2307		
Survival rate (%) C	9	858.33	95.37	54.02933		
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	1496.827	2	748.4136	12.25167	0.000215	3.402826
Within Groups	1466.08	24	61.08668			
Total	2962.908	26				

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## **Disability: Causes, Consequences and Rehabilitative Measures (A Sociological Study Upto the People Age Group of 10-60 years)**

Irshad Ahmad Lone

Research Scholar, Singhanian University, Rajasthan, India

[showkat80ahmad@gmail.com](mailto:showkat80ahmad@gmail.com)

**ABSTRACT:** This paper highlights the causes, consequences and rehabilitative measures among people in general upto the age of 10-60 years. First, disability has various causes some are by birth (hereditary) some are after birth e.g., accident in factories, road accident, building crush, mental tension, exchange of firing etc. Second, disability has significant consequences on individual, family and society. Person of disability feels loneliness: boundless into four walls, economically dependent and medically not treated, unable to work if his/her arm or leg is to be amputated. Socially, their contact becomes limited and psychologically the depression occurs in them. Finally, rehabilitative measures should be provided in the name of disabled persons of all sections of society especially weaker sections, destitute and needy people. In an attempt to study the Causes, Consequences and rehabilitative measures among all strata of society. It examines the impact of different types of disabilities on general population between the age group of 10 to 60 years.

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**Keywords:** Disability, Causes, Consequences, Rehabilitation

### **INTRODUCTION**

The loss or impairment of a limb or deformity in one's physical or mental capability is the worst that can happen to a person, whether it is because of nature's foul play or as a result of an unexpected unfortunate accident. Welfare of the disabled and the handicapped is an extremely challenging task and it can be fulfilled only when all the citizen's, voluntary organizations and government realize their responsibilities in this respect collectively. Disability is a cultural construct based on "Ideal or Social Norm" that has been constructed from assumptions of authority in society. This authority is derived from the fact that each person believes others to be comparable to his own self-identity, in this regard there should be a common mould that all types of people precisely fit. These expectations, however, have failed to take into account the fact that every human being perceives the world from a different view-both physically, through their retinas, and socially through their expectations, beliefs and behaviours. The declaration on the rights of Disabled persons stated that the term, "Disabled persons," means "any person unable to ensure by himself or herself, wholly or partly, the necessities of a normal individual and or social life, as a result of deficiency, either congenital or not in his or her physical or mental capabilities". Therefore it becomes necessary to focus upon each individual as a self-defining entity, whose abilities derive from examining their own self-worth without any outside judgment.

### **CAUSES OF DISABILITY**

The causes of disability fall broadly into three groups such as biological factors, genetic or hereditary factor and accidents. These three causes of disability are responsible for disability worldwide. Social and physical causes are also responsible to increasing disability. As for as present scenario is concerned these causes are responsible for the increasing rate of disability. Biological factor's includes immature birth's and general weakness. Malnutrition is also comes in the biological factor as a cause of disability 'Genetic' or hereditary factor,' is another cause of disability. It includes, hereditary passing genes from one 'disable' person to another. It is actually a genetic disease Genes are responsible for disability. No doubt, it is a biological problem but it should overcome socially with the help of social workers. The remaining factor is accidents. Though accident's in machinery, and road accident's many lost their lives and many become disable. Though the efforts of governmental and non-governmental organization (NGO's) it can be overcome and treated effectively.

In some parts of the world, there are social causes of disability, which includes conflict situation. For example, conflict in India and Afghanistan, Iraq, Kashmir and Palestine's, Somalia, internal conflict in different parts of India, Pakistan, now in Arabian countries and African countries. Social conflict proves most devastating cause of disability. Child labor and child abuse, disintegration of family, unemployment etc also come under the category of

social causes. The child labor is in peak in different parts of the world especially least developed nation's of Asia and Africa, and third world countries. It should be ended at all cost with the help of social workers, Govt, N.G.O's and other voluntarily organization to provide them better rehabilitation and economic help can improve their social status.

### **CONSEQUENCES OF DISABILITY**

There has been a significant consequence of disability on individual, family and society. The person of disability feel's loneliness; boundless into four wall's economically dependent and medically not treated, unable to work if him/her arm or leg is to be amputated. Socially, their contact with others becomes limited and psychologically the depression occurs in them. Such people feel cut off from society and they become victim of their own disability. Social workers and other governmental organization's can come forward to eradicate and overcome the impact of disability on the individual. Society should treat them as challenge of their responsibility to help them to overcome from trauma.

If people are affected with any one of a number of disabilities they know how hard it make their life. People need to learn about a couple of basic disabilities and ways to help live with them. Being blind affect's the life of many people throughout the world. This disability is when people cannot see people, will not be able to see or do many of the things they love. Being deaf is a very awful disability. However, this kind of disability has fewer consequences than some of the others. People may not be able to hear they can still with other people via sign language or some speech if they can learn to read lips. The next big disability is being mute, this is where people cannot talk and cannot make speaking sounds. Disabilities can also include genetic disorders, amputated or lack of limbs, and many other things which cause a person not to be able to lead a normal life. Social security disability or (SSD) I is a division of the Federal Social Security Act.SSD encompasses several programmers that provide monthly disability payments and other benefits to disabled workers and their families.SSD benefits may consist of medical coverage of cash payments. The person who is applying for SSD benefits must have a medically determinable impairment This means that the applicant must have a mental or physical impairment or disability that can be medically diagnosed and established by evidence consisting of signs, symptoms and laboratory investigations. Additionally, this disability must have lasted, or be expected to last, at least one year or be expected to result in death. Finally, the disability must result in the inability to work.

Disability has also impact on the family. If any person in a family has one or more than one type of disability, the whole family will be affected. The savings of the family gone for the treatment of this person. The symptoms of poverty are comes in the family slowly. Consequently, one member for the watch, movement and treatment will be attached to the family. Socially, the family affected by disability would not be prosperous and economically sound.

Society can be also affected by the physically challenged families and individuals. Adequate funds should be given and reserved for these disabled peoples and families. The funds which can be utilized for developmental purposes, diverted to rehabilitation of these disabled people's. The government has to improve the medical facilities in health centre's. Government has to revive their policies for the benefits of the disables. Consequently, society is affected by the disable families and individuals. Keeping the above in view, disability has impact on individuals family and society and Govt. must taken the steps to stop the mentally, physically, Locomotors, hearing and other types of disability.

### **REHABILITATION OF DISABILITY**

Rehabilitation is a process by which disabled people no longer depends on others livelihood. As for as rehabilitation of people with disability is concerned, it looks a difficult job to cope with. Many developed and developing nation's are trying to meet the problems for physically, mentally and hearing disability. According to the international webster's dictionary, or article (1) Establishes the right of self-determination and article (2) guarantees that the right, enunciated in the covenant will be exercised by all without discrimination of any kind, Article 6recognizes the right to work which includes the right of everyone to opportunity to gain his living by work, which he freely chooses and accept. Thus, if disabled person who is able to earn his living by working and is in a position to of inequality vis-à-vis others, this would represent a violation of that right. More than 500 Million people 10% of the world's total population suffers from some type of disability. In the majority of countries, at least 1out of ten persons has physical, mental or sensory impairment and at least 25% of the entire population are adversely affected by disability which needs to rehabilitate.

The problem of disability is gaining more and more importance all over the world..The planners of India all very well understand the significance of the problem. The government of India and also the state government framed various policies for persons with physical hearing, and locomotors disabilities:

- (a) Scholarship.
- (b) Job reservation.
- (c) Concessional assistive devices.
- (d) Concession facilities in training.
- (e) Special training institutions.
- (f) Tax benefits.

An apex body of the council of rehabilitation must be opened in all parts of the world particularly in Indian sub –continent. Its aim is to prescribe the syllabi for the various programmes, recognize the training institutions and maintain rehabilitation registers. To further ensure that the resource persons of the voluntary organizations get proper training in the national institutes, organize refresher courses for the in- service personnel of the voluntary organizations in batches.

#### **Rehabilitation centre scheme on district Level**

It has been estimated that maximum number of population resides in villages all over the world especially for developing, third world nations, South-Asia and African countries. However, the services in the government as well as non- governmental sector's are largely concentrated in urban areas. To rectify this anomaly, the International Rehabilitation Welfare, to be stated at district level with the help of (UNO) worldwide especially developing and poor nations of the world which are prone for disability. Keeping in view, the Indian Ministry of welfare stated the District Rehabilitation centre scheme in 1983.

Besides these facilities, the employment training facilities should be opened at all cast. The ultimate aim of every rehabilitated person is gainful employment. A handicapped person who is employed not only becomes productive member of society but also achieves confidence and self respect in the process. For preparing handicapped persons to take up employment and self employment, training in various vocational activity is provided. Training facilities should be available both in the government and voluntary sectors. Other facilities like loans from nationalized banks at concessional rates of interest for the handicapped persons to set up self – employment ventures must be available. The

government must open reservation for vacancies in jobs. Age relaxation in the name of disabled in different departments must be available.

#### **METHODOLOGY**

The present study aims to study causes consequences and rehabilitative measures of disability and the way that they are affected the health of the age group of 10 to 60 years in general.

#### **OBJECTIVES OF THE STUDY**

1. To understand the problems and queries of disabled people in Kashmir
2. To explore the causes, consequences and rehabilitation of disabled people in Kashmir
3. To study the nature, magnitude and dimension of disability in Kashmir
4. To provide the appropriate measures to alleviate this problem

#### **AREA OF THE STUDY**

The area/universe for this study is the Srinagar city in the Srinagar district of the Kashmir valley. As far as the choice of the Srinagar city is concerned as the universe of the study was made because Srinagar is the biggest District in population of J&K and one of the biggest commercial district and prone to disability.

#### **SAMPLE OF THE STUDY**

The respondents for the study were 10 to 60 years of age who responds those who are not in a position to respond their response are based on observation keeping in view it was decided to contact/consult mostly those who are able to respond to get responses by random sampling.

#### **TOOLS AND TECHNIQUES USED**

After the selection of the sample the methods or techniques to be used by the researcher for the collection of the empirical data was selected. Under the peculiar circumstances, created by the type of research/respondents, the method of interview schedule and observation seemed to be the best possible method.



**District wise Profile of Disabled**

S.No.	District	Total	Rural	Urban
1	Srinagar	34844	7255	27589
2	Budgam	15316	13574	1742
3	Anantnag	30781	26813	3968
4	Pulwama	16003	14375	1628
5	Baramulla	45152	37013	8139
6	Kupwara	20809	19821	988
7	Leh	2717	2228	489
8	Kargil	2892	2577	315
9	Jammu	47514	26969	20545
10	Udhampur	22183	19137	3046
11	Rajouri	15119	14409	710
12	Ponch	14130	13118	1012
13	Kathua	12467	10902	1565
14	Doda	22743	21527	1216
<b>Total</b>		<b>302670</b>	<b>229718</b>	<b>72952</b>

Jammu and Kashmir census report 2001.

**Disability in India**

According to estimate made by the "United Nations" that there are 500 million disabled in the world and 400 million disabled in the developing countries. According to the world Health organisations expert committee on disability prevention, estimate about 10 percent of the world population is disabled which impeded or rendered their participation in social, cultural, economic and political life impossible. In India complete statistics of the disabled are not available however, it is estimated that India has 100 million disabled people. The national sample survey of India 1991 estimated that there are 16.15 million persons having at least one or another type of disability, which constituted 1.9 percent at the total population. 74.3 percent persons with disabilities live in rural areas and 1.6 in urban areas. The persons with locomotor disability are largest in number (7.6 million) followed by those with speech and hearing impairment (4.5 million) are then those with visual impairment (4 million).

As a developing third world, India accounts for 75 percent of the total disabled persons of the globe.

Among the causes of disabilities malnutrition, communicable disease, infection in early childhood is the major causes of disabilities. In addition, nutritional deficiency, inadequate or inaccessible health care services, incompatible consanguineous marriage (Swagotra marriages) are responsible for high rate of disabilities in different forms.

As far as caste's is concerned it is quite high in rural areas rather than in urban areas. According to survey conducted by National Sample Survey Organisations indicates that 5 percent and 8 percent of the total number of visually handicapped in rural and urban areas. In case of hearing, 30 percent in the rural areas 28 percent in the urban areas. As regards speech disability, it is 77 % and 67% in the rural and urban areas. The number of persons having locomotor disability (for one lakh population) is estimated to be 828 for the rural areas and 679 for the urban areas. According to a rough estimate, about 3 million persons are added to this section of society every year. Following table shows total number of disabled in India at 21,96,769 which constitute more than 2 % of total population.

Types of Disabilities Disabled in India by types of disabilities	No. of Disabilities	Percentage
Seeing	10634881	48.55
Speech	1640868	7.49
Hearing	1261722	5.76
Moment	6105477	27.87
Mental	2263821	10.33
<b>Total</b>	<b>21906769</b>	<b>100.00</b>

### Disability in Kashmir

Disabled persons are present in all the societies. It not only affects the families of disables but also the dependents. There is hardly any society where persons with disability are not present. This is the fact also in the case of Kashmiri society. The term "Disabled" persons was defined in the declaration as "any person unable to ensure by himself or herself, wholly or partly, the necessities of a normal individual and social life". According to the Jammu and Kashmir persons with Disability Act 1998, Persons with Disability, means a person suffering from not less than forty % of any disabilities.

The society of Kashmir faces acute disability related problem. The entire population of Jammu and Kashmir has been exposed to the man-made disability on account of prevailing conflict situation in Kashmir. There is no confirmed statistics about the total number of disabled in Kashmir. Therefore one has to largely depend on estimates given by different agencies and individual based organisations. According to 2001 census, only 1.38% of the total disabled of India are in Jammu and Kashmir. Around 1.96 % suffer from disability in seeing, 1.03% has impairment related to speech, 1.12 and 0.62 of the total population with mental disabilities resides in the state of Jammu and Kashmir. According to a research study conducted by a Kashmiri sociologist, Dr. Bashir Dabla, there are more than six hundred thousand disabled persons in Kashmir with almost 50% of them having permanent disability. 3,43,632 males and 2,61,708 females with one or other type of disabilities while 4,59,436 among them lived in rural areas and 1,45,904 in urban areas. 3,02,670 persons have total disability while 2,08,713 had disability in seeing followed by 37,965 having disability in movement. There are 24,879 people with mental disabilities followed by 16,956 with disability in speech and 14,157 in hearing the study said. On mental health and movement disabilities, the research said that the figures about movement and mental disability witnessed alarming increase during the decade ending 2001 because of prevalence of violence in the conflict region and its physical and psychological implications.

According to one estimate there are about four lakh (0.4 million) disabled within the state of Jammu and Kashmir. According to a survey of Jammu and Kashmir Handicapped Associations (JKHA) of the 4.18 lakh disabled in Jammu and Kashmir, more than one lakh are conflict victims. According to report for the policy project of the disability knowledge and research (KAR) program, funded by United Kingdom Department for International Development (DFID), Neither the states social welfare Department nor the council of for rehabilitation of widows, orphans,

handicapped and old persons, whom the central and state government created in 1996, can enumerate the total number of children the conflict has crippled so far. The plight of the disabled in Kashmir cannot be expressed in words.

Though a lot requires to be done to meet the challenges posed in the face of ever increasing number of disabled in the state on account of conflict, the impact of which are manifold on the population of Kashmir. Not only disabled but there are orphans, women and children with behavioural disorders, irritability, depression and other forms of psychological disorder. There is not only physical disability, which is the cause of suffering but also mental disability which need to be rehabilitated. The government should form rehabilitation council with a mission to rehabilitate these disabled people. So, there arises a dire need to rehabilitate these disabled persons in Kashmir.

The steps which Govt and NGO's can take in this regard as.

- GOCT and NGO should stabilize economic condition of disabled people.
- Disabled or physically challenged should be provided free medication and expert counselling.
- They should be given skill-based training, and machines should be given to them on which they can work
- Regular checkups should be organised by the NGO's and Govt organisations to ensure their normal life.
- Children of such people should be given preference over the other or equal opportunities should be given to them.
- Society should accept them as apart of the society.

### CONCLUSION

There are many concerns over here in Kashmir, which need dire attention in this regard. As per the observation made by Professor Bashir Ahmad Dabla, sociology Department University of Kashmir, "there have been serious problems in the rehabilitation over the last 20 years. Quoting an example, he argued that disable people come on roads to show their resentment against government apathy towards them. They are beaten by police and arrested. It is tragic and shameful. Organisations should have been established to ensure that victims are given medical support and counselling to help them to lead a normal life."

Govt should have called experts to form such an institute which would be an example in itself

in victim-ridden society. All the latest facilities including machines should be installed in such institutes to help disabled back to normal. Although, social thinkers in Kashmir have realised the concern of various causes and consequences prevalent here but more focus has been laid only on social rehabilitation. Some important issues, like the general areas of disability seems to be neglected. As we know the goals of 'Rehabilitation' as a profession dedicated to healing and care of the disability in a dignified manner depends very much on 'Governmental policies'. In the recent times rapid changes in the rehabilitation delivery system and social climate have resulted a strain of this rehabilitation and its detrimental impact on disabled persons in Kashmir.

The causes of disability need to be studied before rehabilitation. At the same, the consequences of disability on individual, family and society need to be highlighted. So far as causes are concerned, which includes social, physical, psychological and biological come under this category. Social causes includes failure in life, social pressure etc. Physical causes include –road accidents, mines exploded, industrial accidents etc. Psychological includes- depression and psychological pressure and biological hereditary births, malnutrition which needs to be pointed out. Consequently, disability has also consequence on the individual, family and society which must be taken into consideration. Socially individual becomes alone and feel alienated from the society and him/her talent goes misuse. Economically, disabled peoples are on family which need support of Govt help to cope the economical problem. Alone, without the help of Govt the downtrodden family is not in a position to provide facilities for their disabled family members. Special machines should be installed, on which disabled people can work and earn their livelihood. No such effort has been taken by the Govt. There is a need to hammer home the new ideas to Govt, in order to employ disabled in specially disabled designed industries.

There, should be a great role of the government in the rehabilitation of disabled peoples. They should make such policies which will benefit the whole society. Social, psychological, physical and biological rehabilitation has important place in sociology. Not alone government, but also N.G.O's has very important role to play. The cooperation of parents and civil societies cannot be ignored. Not only this 'Philanthropists' and economically sound persons can come forward with vast resources to help the rehabilitation process.

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## The strategy for creating creativity in employees

Vahid Khalatbari Limaki<sup>1,2\*</sup>

1- MSc student, Department of Public Administration, Qaemshahr Branch, Islamic Azad University, Qaemshahr, Iran

2- Expert in Central Bank of the Islamic Republic of Iran

\*Corresponding author: Vahid Khalatbari Limaki,  
E-mail: khalatbarivahid@yahoo.com

**Abstract:** The most human achievements in cultural (art, literature, and philosophy and ...), economic, military and appliances fields and ... from the simplest to most complex ones are the product of creativity and innovation by scientists which has been formed during years as today shape through processing ideas, theories and innovations and at first has been created as the most preliminary form in creative human, then over time has been evolved in the path of knowledge growth. In this process, thinkers took steps toward establishing and offering new concept or theory – which sometimes was in contrast with previous theories – through using proper elements of ancient's efforts and realizing their latent talents and increasing power of looking what is available and what is not available, right and could add reality to material and spiritual human achievements. The main managers' responsibility is to keep organization sustainability and survival and also help to grow and develop and increase profitability. Fast growth of enterprises, rapid changes of components of environment, increased competition, and increased environmental uncertainties caused that, organizations creativity subject enjoyed high importance. This paper seeks to explain different ways of creating creativity.

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**Keywords:** creativity, employees, organization

### Introduction:

Increased creativity in organizations can lead to improved quality and quantity of services, no sources loss, and decreased bureaucracy and consequently increased efficiency and enhanced motivation in job satisfaction by employees.

Growing creativity and its production (i.e. innovation) in inputs results in enhanced level of employees' effectiveness and efficiency especially in educational sections then according to process of creative problem solving in ideal circumstances (truth seeking, idea seeking and solution seeking) the organization can coordinate with changes in system and access to goal of more efficiency.

Creativity and innovation is prerequisite and prologue for development, progress and ascendancy of organization and society and it is necessary for interested employees and researchers to be aware of texts and its techniques.

### Creativity definition

Creativity means offering modern thought and plan for improving quality or quantity of organization activity (performance improvement) such as increasing efficiency i.e. increased productions or decreased costs services – better methods and new services ( in organizational perspective). As it can be seen, creativity has positive relation with efficiency

and causes increased level of performance in the organization.

Creativity is a mental process which leads to problem solving, idea making and concept making that are new and unique.

Creativity is capacity for looking new relations, establishing unusual ideas and go away from traditional template of thinking.

### Creativity features

- 1- Creativity is an intellectual-mental process
- 2- Production of creativity can emerge as an effect, idea, solution, behavior or anything else
- 3- Production of creativity is a new phenomenon (innovation)
- 4- Production of creativity enjoy value in addition to novelty
- 5- Creativity is a public ability and almost exists in all people
- 6- Creativity can be grown and positively related with social environment

**Differences between creativity and innovation**

Generally, creativity means ability to integrate ideas uniquely or establish unusual relation between thoughts

**Innovation:**

Process of capturing creative idea and converting it to service production and new method of operation. One of the tasks for managers is to find and identify creative minds in the organization in order to use their thoughts in the organization.

**Importance of creativity in the organizations**

We live in the age of changes and transformations. Organizations are micro-systems of society system which work under such conditions. Undoubtedly, these organizations require applying such changes and constant restructuring in order to supply their conditions and continue existence. This reconstruction will be performed through coordinating goals with current situation and modifying and improving methods of fulfilling this goal. Without reconstruction, the organization cannot stay longer.

Creativity is needed for organization survival. Over time, uncreative organizations will disappear from the scene and however such organization maybe can be successful in the operation in which involved but finally should stop or change the system. Changes in environmental and customers' need are main source of need for change in the organizations. This change can at service for production, service, technology, commercial structure, worker relations or any part else and what is new in recent decade is speed of interesting changes in different fields.

What is more clear today for organizations is the necessity for predicting ways for supplying needs which maybe appear following by possible changes, later and each organization should make itself ready for these changes beforehand or accept risk of confrontation with real crisis conditions.

**Strategies for enhancing creativity**

## 1) Using strategy of focus and simplicity:

Creativity must do one job otherwise people will be confused. Effective creativity begins from small points. They have not been great from beginning and have been designed for doing one certain job. Creativity moreover than be production of genius is production of working. Creativity requires knowledge, skill and focus. Obviously, people enjoy more talent for creativity but they are limited to certain field.

## 2) Creativity education:

Creativity and innovation is an issue which always its necessity have been needed. Therefore, it should be

institutionalized and considered as organizational work and culture. Whenever top managers and policy makers don't believe creativity and innovation as necessary and critical activities then no activity will stay longer in this field.

## 3) Using techniques to foster creativity:

Generally, techniques for enhancing creativity are:

## 3-1) brainstorm:

In this technique, a problem is given to one small group then we asked them to react it impromptu and give an answer.

## 3-2) problem solving method:

Using problem solving method is one of effective mechanism in fostering employees' creativity abilities. When this being created as a custom in employees (i.e. think when face with problems and use intellectual ideas in order to find new solutions) then creativity will be facilitated. Fields for creativity and innovation should be prepared through ruling out logical thinking process.

**Conclusion:**

Increased creativity in organizations can lead to improved quality and quantity of services, no sources loss, and decreased bureaucracy and consequently increased efficiency and create motivation in job satisfaction in employees.

Growing creativity and its production (i.e. innovation) in inputs results in enhanced level of employees' effectiveness and efficiency especially in educational sections then according to process of creative problem solving in ideal circumstances (truth seeking, idea seeking and solution seeking) the organization can coordinate with changes in system and access to goal of more efficiency.

Creativity and innovation are prerequisite and prologue for development, progress and ascendancy of organization and society and it is necessary for interested employees and researchers to be aware of texts and its techniques.

Undoubtedly, we need realistic programs for supplying future needs of organization and the prerequisite for this issue is to use new ideas in managerial plans. Every very successful planning requires hundreds of ideas and thoughts. Final success and in some cases survival of organization itself depends on planning for creating and using new thoughts.

Here, creativity can play significant role through making and finding new thoughts and innovation while using thoughts. However as it was mentioned, creativity is not enough merely in managerial perspective.

Thought should be come into practice and this should be done through planning. At last, todays according to modern managerial theories, one of the main components and tasks of managers is to create needed field for appearing innovations and creativities to make changes in organizations in order to be consistent with unpredictable environment. However today, managing innovation and creativity is one of main components of management in the organizations.

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**Information and Communication Technology (ICT) - Significance in Research & Infrastructure Development**Vandana Dabla<sup>1, \*</sup>, Pradeep K Dabla<sup>2</sup>

1. Research Scholar, Faculty of Public Administration, School of social Sciences, IGNOU, Delhi-110068, India
2. Assistant Professor, Department of Biochemistry, Chacha Nehru Bal Chikitsalya, Associated to MAMC, Delhi-110031, India

Email: [vandana.dabla@gmail.com](mailto:vandana.dabla@gmail.com)

**Abstract:** Information and Communication Technology (ICT) has made a tremendous advancement in recent years. It has led to improvement in many areas from life sciences to industry and from traditional physical library to modern digital library. The word information technology has been changed in all corners of the global areas leading to formation of unique single global society. In this new era of global economy the information technology has begun to play important role in contributing strategic planning process within the organizations to achieve competitive advantage. Present paper discusses the use of ICT in R & D libraries explaining the digital library and the infrastructural facilities and barriers in use of ICT in R & D libraries, significance of ICT in education and economic development, scope of ICT formulation in developing countries infrastructure and its policies constraints and desirables. From this study it confirms that ICT tools are integral part of all round development.

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**Keywords:** Information Communication Technology, Digital Library, R&D Library, Developing Countries, ICT Policies constraints, ICT desirables

**1. Introduction**

Information and Communication Technology (ICT) is being increasingly used in library and information services for the acquisition, storing, processing and dissemination of information. Libraries and information centres have been using ICT based resources and services to satisfy the diverse information needs of their users. At the same time it is found that the use of information and communication technology has become increasingly important in R & D libraries. R & D libraries are switching over to ICT based resources and services at an accelerated pace. E-journals, CD-ROM databases, online databases, e-books, web based resources and a variety of other electronic resources are fast replacing the traditional resources of R & D libraries. Technology application in libraries is raising awareness about the use of Information Technology in R&D libraries specifically information processing, organizing, storing, searching and retrieving Information. The significance of ICTs is realized in many aspects such as improved access to learning by all (Kaino, 2007), creation of conducive learning environment by gender (Kaino, 2007), quality of knowledge delivery (Kaino, 2008), expanded secondary and post secondary education, reduction of expenditure on training and many others. This is to the advantage of advances in Information Technology (IT) that have changed ways of communication in education and delivery of knowledge to society.

The contribution of academic knowledge to economic and social development of societies is widely emphasized. This recognition has raised attention to the role of higher learning institutions such as universities in research outputs and their relevance to society. Universities have the role not only to teach and carry out research but also to contribute directly to economic growth of the society in which they were embedded (Etzkowitz, 2002). University research has a potential in the contribution to achievement of Millennium Development Goals (MDGs) such as Education for All (EFA) goals and expanded access to secondary, vocational and higher education by 2015. Set for the year 2015, the MDGs are an agreed set of goals that can be achieved if all actors work together and do their part (MDGs, 2008).

**2. Trends & Revolutions in ICT**

The new delivery technologies such as electronic learning (e-learning) in virtual programs, internet courses delivery strategies, audio and video communications have changed and challenged ways of knowledge delivery in the education sector.

The *first revolution* comprised of films, radio, television and satellite broadcasting, while the *second* comprised telecommunications and microcomputers (Paisley, 1985). The integration of telecommunications and microelectronic technology in computing was termed a "*third revolution*" and came to be what is called Information Technology (IT). The third revolution was said to promise not



only a more productive person, a problem-solver and a lifelong learner, but also a better informed, rational and participative citizen, a modern 'renaissance' person, living in the web and network of a worldwide electronic community (Papagiannis et al. 1987). This latter revolution came at a time when there was increasing financial and economic stress in many countries of the world.

The current "fourth revolution" in ICT has a globalization component force that has replaced other revolutions and accelerated its influence worldwide. Globalization has been described as the intensification of interconnectedness, a process of elimination of economic borders and increase in international exchange and transnational interaction (Dolan, 1993) and a process by which peoples of the world are incorporated into a single global society.

### 2.1 Digital Library

The new digital libraries, extends the concept of library far beyond physical boundaries with features not possible in traditional libraries. They will provide innovative resources and services. It increases the ability to interact with information: rather than presenting a reader with a table of numbers, digital libraries allow users to choose from a variety of ways to view and work with the numbers, including graphical representations that they can explore. With the extensive use of hypertext links to interconnect information, digital libraries enable users to find related digital materials on a particular topic" (PITAC, 2001). This vision of digital libraries is funded by agencies such as the National Science Foundation. In 2002 movie version of the H.G. Wells classic science fiction novel, *The Time Machine*, portrays the library of 2030 as Vox, a holographic character who walks, talks, and sings excerpts of the library materials in response to user queries (Winograd, 2002).

Supporting diverse information uses that facilitate interaction in these repositories and libraries beyond searching and browsing is however, still in the early stages. Such dynamic and multimedia-based interactivity is important as distances across the globe shrinks, brings diverse cultures into contact with one another, and the research and learning functions of a library are better fused to help in both activities. Coleman and Oxnam (2002) define interactional digital libraries as being made up of information spaces, learning spaces, and interaction spaces. McKnight (2000) uses information space to mean "objects (real or virtual) to which the individual turns to acquire information. In the interactional digital library, information spaces are increasingly made up of heterogeneous formats which can be called complex objects. These objects are structured

as learning spaces; i.e., they display the best information for learning in an optimal manner. Summarizing, we can say that **Interactional Digital Libraries** are:

- Information spaces with complex objects
  - It provide interactions beyond information discovery, searching and retrieval
- Components of such libraries are:
- Collections (content)
  - Services (information discovery, searching, identification, inventory, metadata creation)
  - Tools for information use (annotation, personalization)
  - Interfaces (for searching, for browsing, for creating metadata)

## 3. Significance of ICT

### 3.1. In Education

The delivery of knowledge using ICTs has influenced the design of various educational programmes nationally and globally. Through the computer network, learners were able to communicate with the instructor on the material and could discuss assignments involved. In this process learners were able to attend lectures "online". Technologies in e-learning such as AulaNet tend to provide a groupware for creation, participation and maintenance of Web-based courses emphasizing group learning where individuals shared ideas online (Fuks, 2000). It has been argued that ICT was a way to move from elite to mass education through digital media where more learners could get access to education for both campus and distance-learning students. While the benefits of these technologies have been acknowledged there have been some constraints of adoption especially in developing countries including, access to computers (email and internet), affordability of computers and connectivity, telephone and electricity infrastructure, computer literacy, expertise, etc. (Sibiya, 2003). While such problems have been acknowledged, the main reasons behind the slow pace of adoption have been identified as lack of effective policies on ICTs.

Recent changes in universities in developed countries suggest an entrepreneurial model of academic research. The key feature of this model is said to be accepted by universities that have the responsibility not only to provide teaching and carry out research, but also to contribute directly to economic growth of the society (Etzkowitz, 2002). The triple helix model (of academic-industry-government relations) by Etzkowitz et al. (2000) outlines the entrepreneurial paradigm that describes an "entrepreneurial university" as the one that encompasses a 'third mission' of economic

development in addition to teaching and research. This model involves both internal development of the university and external influences on academic structures associated with the emergence of knowledge based innovations.

### 3.2. In Economic and Social Development

The significance of ICTs in economic and social development of societies is now widely recognised and the need for higher learning institutions to contribute knowledge in this area is emphasized. There are many ICT studies that have been conducted by these universities, and how the projects have benefited or intend to benefit the communities in these countries is not yet explored and disseminated to researchers in neighbouring universities. Also how this knowledge has been disseminated for the benefit of the people in the region is not known. The university research on ICTs has place in realization of Millennium Development Goals (MDGs) by year 2015 which would alleviate poverty if they are achieved. Dissemination of ICTs knowledge to targeted groups in community can increase access and participation in educational, social and economic activities that are believed to contribute to well being of society. Currently, it is proper to take the advantage of the versatility of ICTs that provide a conducive interaction nature for participation of both sexes. It is yet to be encouraged and popularized in developing countries where some traditional approaches have to be innovated with current technologies for development.

## 4. The Scope of ICT Infrastructure in Developing Countries

### 4.1 Human Resources (skills)

With the increased importance of information technology within organizations, the role of the IT executive has taken on more of a strategic rather than a support function. The IT executive in today's organization is usually charged with the responsibility of developing and implementing the strategic information system plan for the organization (Enns et al. 2001). In most organizations, the senior IT executive is the person that would be charged with the responsibility of transforming the IT department to fit the needs of the new market environment which requires significant leadership skills. In a survey conducted between September and October 2001, and published in the CIO magazine (2002), it was highlighted that the three skills that are most important for the IT executive to succeed are communication skills, understanding the business processes and strategic planning. The ability to maintain and utilize the technology to its fullest capacity is one of the major components of effective

technology development and management that will lead to economic growth. Within a developing country environment the lack of local technical and managerial skills can cause the cost of this development, maintenance and management to be far greater than it would be in developed regions. The "brain drain" of professionals from developing to developed countries makes it extremely difficult and expensive for developing countries to advance in technological development and effective management. The availability of a local pool of skilled IT executives will be affected by the quality and level of investment in IT and other technical and managerial training as well as the migration rate of competent individuals from the country (Hawkins 2002).

### 4.2 Technology Infrastructure

Innovative technologies have rapidly changed the way the world communicates and does business. Participation in this new global economy requires each country to have a scalable and flexible network infrastructure that is economical and technically reliable. Comparatively, developing countries traditionally tend to have a more inferior computer technology infrastructure than developed countries. In the year 2000, countries such as Jamaica had an average of 199 mainline telephones and 39.4 personal computers per 1000 people, while the US had 700 mainline telephones and 585 personal computers per 1000 people (World Bank, 2002).

A study conducted by the World Economic Forum sought to identify how ready individual nations were for this global networked world. A network readiness index rank was derived using factors such as network use, others were network access, network policy factor, networked society factor, networked economy factor. These four enabling factors were then used to determine an overall network readiness index rank. A ranking scale of 1 (top) to 75 (bottom) was utilized. Countries such as the US, Finland and Singapore are ranked in the top ten, with ranks of 1, 3 and 8 respectively, while countries such as Zimbabwe and Nigeria rank at the bottom of the scale with ranks of 70 and 75 respectively (Kirkman et al. 2002).

### 4.3 Economic and Government Policies

The economic state of any country will affect the ability of that country to invest in information technology infrastructure and implement technical and managerial programs in public schools and universities. The prevalence of imperfect markets in developing countries also adds to the challenges faced by IT executives in developing regions. The procurement and taxation policies of government, the

exchange rate of the local currency, inflation as well as tax incentives and special discounts to public and private sectors can all have an impact on the implementation and management of technology in developing countries (Seally, 2003). Increased involvement by the private and public sectors will also have a positive effect on the management of technology throughout the country.

### 5. ICT policies Constraints

One of the main obstacles to adoption of ICTs in developing countries in particular, has been identified as ineffective policies in government departments (Kaino, 2004). While much efforts have been made to stipulate ICT policies, not much have been done on the implementation side and especially on the structures and processes in place. Different institutions and departments interpret the policy in various forms for implementation.

The policy has no gender dimension not only on ICT but on education as a whole. The latter aspect was observed in many countries in the region as shown by data on access, participation and expenditures on education (Kaino, 2007). To realize full impact of ICTs, educational policies and programs need to be coordinated with those in other ministries, such as economic development, human resource development, telecommunications, agriculture, rural and urban development. Countries like Singapore and Finland have national plans for implementing ICTs in education. Typically the plans describe the hardware, software, and networking that will be implemented in schools as well as technical support and training of teachers.

The national plans should specify measurable goals, authorize and fund specific programs and projects to advance the vision and provide the resources needed to implement them. Policy leadership is key to any successful development strategy, particularly if these efforts are to contribute to economic and social transformation, for example in Finland, successful development was guided by a clear vision of how the availability of new technologies could increase economic productivity, improve the quality of life and enrich the culture .

#### 5.1 ICT associated Strategy Development

Studies in the field of knowledge utilization are based on two designs: the *discrete event design* and the *decision-making process design*. In the **first design**, respondents are asked to identify how the findings of a single study affect a discrete decision by the users of research. According to Weiss (1980), instrumental use is rare and when observed, it would tend to be more frequent in private than in public organizations (Dunn, 1980). In the **second design**,

respondents are asked to identify how the knowledge produced across all stages of the research process influence all the spectrum of the stages of the decision-making process of the users (Landry, Amara and Lamari, 2000). An assumption that a discrete decision can be attributed to the use of a discrete research report has been considered to be simplistic because research findings generate many effects, not a single effect, and because decisions do not depend on a single piece of research, but on a series of research results converging toward one direction.

Empirical evidences regarding the particular categories of factors that explain the utilization of knowledge in a statistically significant manner has been debated for a number of years. More recently, the importance of other exploratory factors such as dissemination and linkage and exchange between researchers and users of research output is stressed. The one-way flow of information and “traditional” dissemination approaches have not proven to be effective in encouraging the adoption and implementation of new research results. When researchers invest resources to adapt their products as to facilitate their appropriation by users, it increases the use of research. The lack of interaction between researchers and their potential audiences has been identified as the main problem in under-utilizing research findings. This diagnostic has given rise to the interaction explanations (Lamari, 2000).

It suggests that knowledge utilization depends on various disorderly interactions occurring between researchers and users rather than on linear sequences beginning with the needs of the researchers or the needs of the users. The mechanisms linking researchers and users considered include informal personal contacts, participation in committees, and transmission of reports to non-academic organizations. It was premised that the more resources the users and researchers invest in these types of linkage mechanisms, the higher the use of research.

### 6. Influencing factors & barriers for ICT

#### 6.1 Technology Related Factors

1. **Cost:** It is still a critical barrier. Even the adopter of ICT is unwilling to upgrade the information systems or to adopt other advanced ICT service applications because of the high adoption cost. On the other hand, the lowered price of ICT service platforms caused them to change their business partners or to disconnect them.

2. **Maintenance and Training:** The technological knowledge can be a barrier to the adoption and extension of the information systems. Some CEOs are worried about the introduction of ICT because of the fear that their employees might be

not familiar with it. Fear factor (Security, technology): The fear of the leakage of company information, such as the transaction and the accounting information can be a critical barrier to indirectly or directly adopting and extending implementation of new ICT service applications.

**3. Technology availability:** It influences directly to ICT adoption. The companies may find difficult to sustain the ICT adoption, while some may points out that the absence of a suitable application program, including the lack of the development of an application, is one of the barriers to adopt new ICT.

## 6.2 Organizational Environment Related Factors

**1. Awareness:** It estimates the awareness of ICT adoption and of business extension via ICT.

**2. Perceived benefit:** It includes the expectation of benefits of new ICT that organisation may try to adopt as the perceived benefit. The perceived benefits are highly related to new ICT adoption through previous experience.

## 6.3 Business Related Factors

**1. Outsourcing elements:** This factor is closely related to the cost of management or transaction and the capability of organisation. Krajewski and Ritzman (2002) describe outsourcing as “allotting work to suppliers and distributors to provide needed services and materials and to perform those processes that the organization does not perform itself.” However, after using the ICT service platform, the CEOs had to entrust it to a certified accountant with a high expenditure. These outsourcing elements and the existence of the alternatives (ICT) can be an excellent anti-barrier that helps to adopt ICT. This change comes from the increasing trend of the on-line transaction.

**2. Buyer and Supplier:** This is a barrier and driving factor e.g, one has difficulty sending its estimates and blueprints to the customers on the Internet because the main customers are women in their 50s who are not familiar with the Internet. Therefore, it has to retain both an online and offline business structure. In addition, other has used an accounting program that enables them to do Internet transactions according to the increasing trends of Internet business. This type of problem can be a barrier to extend the internet business.

**3. Business partner:** Organisations, who are subcontractors or agents of the big enterprises that use EDI or e-commerce, tend to adopt an EDI system or e-commerce solution (KIMI, 2003).

## 6.4 Government Related Factors

**1. Cost related financing:** According to the KIMI study (2003), most organisations desire various and appropriate support from the government. Among them, especially in financial supports their major requests are divided into three groups: The support of the standardization and the development of ICT service platforms (41.3%), supporting training programs (27.5%), and loan and fund financing (57.9%).

**2. Cooperation Work:** They are divided into five business domains: Content Service, Telecommunication Service, Application Service, Web-hosting, and online training. Owing to the sharing of work between the members of the consortiums, service providers, as members of the consortium, can afford to reduce the cost of development of ICT service platforms.

**3. Information channel:** ICT information comes through various channels: an acquaintance, customers, the Internet, newspapers, etc. Ironically, many organisations could reach the information of ICT service platforms not from marketers or advertisement of the ICT service providers, but from their acquaintances and other parties.

## 7. Goals & Desirables

### 7.1 ICT development Goals

The ICT policy framework should basically have an ICT for development approach. The ICT for development approach is to analyze objectives, institutional frameworks, local capacity and development benefits of ICT. The ICT policy principles to be considered in the framework, to increase impact on targeted communities and marginalized groups are:

1. Policy decisions on the type and location of technology by local community based on needs of the target groups.

2. Nature of dialogue with target groups about information they wish to communicate, the most appropriate communication of this information, and impact an ICT project have on cultural and social norms of the community.

3. Understanding of different ways in which people learn, communicate and use information when designing an ICT program.

4. Incorporation of monitoring and evaluation during project design, and impact assessment and ensuring these components are implemented.

5. Design process of holistic projects: incorporating the social, economic, and communication systems already in place in the target group.

6. Nature of creation of partnership with public and private institutional infrastructures; building on

existing formal and non-formal organisations and communication networks.

7. Nature of provision of ICT skills at all levels, according to community need. Paying attention to youth, women and marginalized groups.

### 7.2 Research Libraries Desirables

1. Research libraries should adopt a hybrid collection development policy.

2. All research libraries should concentrate on procuring online database of journals, books, patents, thesis/ projects and others.

3. Majority of research libraries should give stress on need-based, value added users services through automated library.

4. For the new digital environment the existing rare and valuable documents should be digitized in a phased manner for preservation and for future use.

5. All research libraries should catalogue, classify and Index the web-resources for the effective use.

6. All research libraries should safeguard their resources by implementing any one of the electronic security systems in addition to professional security. It may be video cameras, closed circuit television, electronic security systems, etc.

7. Research library professionals should get wide varied user education programmes for maximum utilization of Information Technology based library facilities and services.

### 8. Conclusion

Researchers have become increasingly reliant on IT tools to reduce the costs and boost the productivity of R&D sciences. Bioinformatics employment opportunities also have been expanding. The Research & Development libraries have given due recognition and importance in terms of collection, budget, infrastructure facility, staff and users. In the Meanwhile they are using Information and Communication Technology, as a source for book selection, display of new arrivals for library publications and for database creations.

Developing countries world-wide are characterized by weak currencies, weak economies, imperfect markets, inadequate technical and other physical infrastructures, inadequate management and technical skills, inadequate public education facilities and limited economic resources. In order to gain the benefits of these innovative technologies organizations in developing countries must undertake various transformation and restructuring processes in order to benefit from economies of scale and scope by sharing their physical and human resources. Effective management of technology in developing regions can lead to organizations in those locations

being able to improve productivity, increase competitiveness and take advantage of various economic opportunities globally, thereby leading to long-term and sustained growth of industries in those regions.

### Corresponding Author:

Vandana Dabla

Research Scholar, Faculty of Public Administration, School of social Sciences, IGNOU, Delhi-110068, India

Email: [vandana.dabla@gmail.com](mailto:vandana.dabla@gmail.com)

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**【5】。 对广义相对论方程的质疑——《1》**  
**——广义相对论方程的根本缺陷是没有热力学效应，既无热力以对抗引力——**

张洞生

Email: [zhangds12@hotmail.com](mailto:zhangds12@hotmail.com); [zds@outlook.com](mailto:zds@outlook.com);

**《内容摘要》**：现在爱因斯坦的广义相对论方程几乎与所有当代的物理学的最新观念联系在一起。比如，宇宙起源，奇点，黑洞，零点能，真真空能，N 维空间等等。然而，已经观测到的真实的物理世界往往证实这些与广义相对论方程相结合的新观念的虚幻性和谬误。其中最明显而困惑科学家们数十年的“奇点”问题就是其中之一。宇宙中根本没有具有无穷大密度“奇点”存在的任何迹象。再如，按照 J. Wheeler 等估算出真空的能量密度可高达  $10^{95}\text{g/cm}^3$ 。<sup>[4]</sup> 这些都是不可思议的。既然由推导和解出广义相对论方程得出“奇点”的结论不符合客观世界的真实性，这证明广义相对论方程本身有无法克服的缺陷。作者在本文中的目的就在于明确地指出了在场方程中，既无每个粒子的热力以对抗每个粒子的引力，因此，所有物质粒子的纯引力收缩必然违反热力学规律，使粒子团必然塌缩成为宇宙中不存在的‘奇点’怪胎。因此，把每个粒子真实的热抗力（温度及其变化）加进到能量-动量张量项的每个粒子中去，才是改善场方程的治本方法。但这将使场方程变得更为复杂难解，所以近百年来，无人能够作到。

**[张洞生. 对广义相对论方程的质疑——《1》——广义相对论方程的根本缺陷是没有热力学效应，既无热力以对抗引力——. Academia Arena 2013;5(7):35-39] (ISSN 1553-992X). <http://www.sciencepub.net/academia>. 5**

**《关键词》**：广义相对论方程；场方程的根本缺陷；场方程违反了热力学定律；奇点；普朗克领域

**《1》**。现在爱因斯坦的广义相对论方程的宇宙学项几乎与所有当代的物理学的最新观念联系在一起。比如，宇宙起源，奇点，黑洞，零点能，真真空能，暗能量，N 维空间等等。或者说，所有这些新观念都被新潮的物理学者塞进广义相对论方程以便能披上一件合乎主流理论的外衣。然而，已经观测到的物理真实往往证实这些与广义相对论方程相结合的新观念的虚幻性和谬误。其中最明显而困惑科学家们数十年的“奇点”问题就是其中之一。宇宙中根本没有具有无穷大密度“奇点”存在的任何迹象。然而，近四十年前，R·彭罗斯和霍金发现广义相对论存在空时失去意义的“奇性”；星系演化经过黑洞终结于奇点，宇宙开端有奇性。甚至可能存在“裸奇性”，于是不得不提出‘宇宙学原理’和“宇宙监督原理”（hypothesis of cosmic censorship）来，又加上等压（零压）宇宙模型等，以规避理论的错误。奇性，这一理论病态的发现是理论研究的重要进展，却又与等效原理不协调。<sup>[3]</sup>

**《2》**。广义相对论方程是爱因斯坦头脑中的产物，不是建立在坚实可靠的实验的基础上的，而且当时还没有宇宙膨胀的概念。从物理学上来讲，广义相对论方程中只有物质粒子之间的引力而无对抗引力的斥力是先天不足的，是无法解出物体内部粒子的运动轨迹的，因为宇宙中任何物体的稳定存在都是其内部物质及其结构的引力与斥力相平衡的结果。一个只有粒子纯引力的场方程必然使每个粒子都处在不稳定的运动中，其最

后的归宿只能是向其质量中心收敛成密度为无限大的‘奇点’，这是违反热力学定律即因果律的结果。而后来从外部加进出的具有排斥力的宇宙常数  $\Lambda$  也是后天失调的，因为这种斥力是加在作为研究对象（系统）的物质粒子团的外部，所以其斥力的效应只能是引起物质粒子团的整体运动，而无法对抗粒子团内部粒子们的引力收缩，以便能求出粒子的运动轨迹，也无力对抗粒子团的引力收缩奔向‘奇点’。

**《3》**。爱因斯坦于 1915 年建立了广义相对论。尽管他的假说甚至有错误，但是广义相对论方程将时空结合的宇宙观却有划时代的哲学和科学意义，仍是划时代理论（对于时空的非对称性的无法解释是该理论的另一重大缺陷）。<sup>[1]</sup>按照爱因斯坦通俗的解释，如同钢球会把绷紧的橡皮膜压弯，太阳会使其周围的空间时间弯曲。由此，他说明了牛顿引力无法解释的水星近日点的剩余进动，预言经过太阳附近的光线会偏折等。牛顿体系是一个没有完成的理论体系。<sup>[3]</sup>爱因斯坦以狭义相对论为基础，发展到广义相对论，进而建立相对论性宇宙论的相对论体系，包含了牛顿体系的合理内容，克服了牛顿体系的一些重大疑难。爱因斯坦之后，有关广义相对论和宇宙论的研究也取得了一些进展。但是，总起来说，仍然乏善可陈。因为这个体系也是一个没有完成的伟大体系。<sup>[3]</sup>晚年的爱因斯坦写道：“大家都认为，当我回顾自己一生的工作时。会感到坦然和满意。但事实恰恰相反。在我提出的概念中，没有一个我

确信能坚如磐石，我也没有把握自己总体上是否处于正确的轨道。”这位创造了奇迹，取得划时代伟大成功的科学巨匠，以他的辉煌，谦虚地陈述着一个真理。<sup>[3]</sup>

《4》. 广义相对论方程本身的根本问题和无法克服的缺陷是没有与热力学联系在一起，也就是说没有时间方向。因此得出一团物质粒子自身的引力收缩会成为“奇点”的荒谬结论。热力学定律是宇宙中最根本的规律，是因果律在物理学中的化身，在以质子为物质世界基石的宇宙时空里，任何普遍（适）性的理论如果不与热力学结合在一起，必然难以成功。现有的广义相对论方程的各种解都有 2 个最主要的假设前提：一是质量守恒。二是零压（恒压）宇宙模型，即不考虑温度变化而产生的热压力改变。正是这 2 个假设违反了热力学定律，而最终导致用广义相对论方程解出一团物质的引力收缩到会成为违反热力学定律“奇点”。

《5》. 现在假设有一大团定量物质粒子 M 收缩时，

1\*. 当 M 在绝热条件下由状态 1 改变到状态 2 时，根据热力学第二定律，热量 Q，熵 S 和温度 T 的关系应该是  $\int TdS = C + Q_2 - Q_1$ 。在  $Q_2 - Q_1 = 0$  时，因为熵总是增加的，所以温度 T 必然降低。这就是说，假设有一大团定量物质粒子 M 在自由绝热状态下改变其状态时，只能降温膨胀，绝对不可能靠其粒子的自身的引力产生收缩。

2\*. 在  $M = M_1 + M_2$  时，根据热力学定律，如 M 在绝热过程中，当其中  $M_1$  部分收缩而使得其温度增高和熵减少时，必然使其另一部分  $M_2$  的熵的更多的增加。这就是说， $M_2$  必须作为能量或物质从  $M_1$  中排除出去，才能使  $M_1$  收缩和提高温度减少熵。如能继续收缩，结果就是  $M_1$  会愈来愈少，而发射出去的  $M_2$  愈来愈多。这就是宇宙中一团物质（包括黑洞）在实际过程中，符合热力学定律的收缩。当物体中的热量无法排出或有外界供给足够的热量时，物体是不可能收缩的。

大家都知道，无论是制造液体氮还是液体氧，都需要外界加压和排出热量降温 2 大条件，它们才能增大密度而收缩。这就是自然界符合热力学规律的增大密度而收缩的客观的实际过程，宇宙中根本就不存在如场方程所假定的、一团粒子等压不排热的自然收缩以增大密度的过程。所以场方程的假设前提是违反自然规律—热力学规律的，必然造成出现‘奇点’的荒谬结果。

3\*. 当  $M_1$  因发射能量-物质而收缩到史瓦西条件时，即  $M_1 = C^2 R_1/2G$  时， $M_1$  就成为黑洞。其视界半径将能量-物质  $M_1$  都禁锢在黑洞内，并吞噬外界的能量物质。当外界没有能量-物质可被黑

洞吞噬时，黑洞只能不停地逐个的发射霍金辐射量子。使  $M_1$  收缩变小的极限就是最后成为最小黑洞  $M_{bm} = (hC/8\pi G)^{1/2} = 10^{-5} \text{ g}$  时，在普朗克领域解体消失。<sup>[1]</sup>可见，彭罗斯和霍金是假定永远符合质量守恒和零压宇宙模型的条件而得出场方程会收缩为“奇点”的结论的。这是违反实际过程中的热力学定律的。

《6》. 在真实的宇宙或者一团定量的 M 物质粒子中，状态和温度的改变是如何影响粒子  $m_s$  在外部和内部的运动的？假设有质量为 M 的物质粒子团在半径为 R 的橡皮球内，温度为 T。设橡皮球的弹力忽略不计。

1\*. 当  $m_s$  在 R 的外面，距离球中心为  $R_s$ ，因此  $m_s$  受 M 的引力作用在 M 外作测地线运动， $R_s$  的曲率半径为  $K_s$ 。当 M 绝热膨胀到  $T_1$  时，半径增大为  $R_1$ ，即  $R_1 > R$ ，这表明 M 距离  $m_s$  更加近了，引力也加大了，所以此时在 M 外面的  $m_s$  运动的曲率半径变成为  $K_{s1}$ ，于是  $K_{s1} > K_s$ 。

2\*. 当 M 因排热收缩到  $T_2$  时，半径减小为  $R_2$ ，即  $R_2 < R$ ，这表明 M 距离  $m_s$  更加远了，引力减弱了，所以此时  $m_s$  运动的曲率半径变成为  $K_{s2}$ ，于是  $K_{s2} < K_s$ 。

3\*. 如果  $m_s$  在 M 内部，当 M 膨胀或收缩时，由于 R 的增大或减小， $m_s$  的位置和其运动的测地线也会随着改变。可见，解广义相对论方程所假设的“零压宇宙模型”是与真实的物理世界不相符的。温度对物质粒子在外部和内部运动的影响在任何情况下都存在，而且是不可以忽略的，忽略就会出现“奇点”。其实，这就是定性的将宇宙常数  $\Lambda$  引进广义相对论方程中的能量-动量张量内部进行分析的结果，这相当于引进一种能量密度为  $\rho_\Lambda = \Lambda/8\pi G$ ，压强为  $p_\Lambda = -\Lambda/8\pi G$  的能量动量分布，问题还在于这种  $\rho_\Lambda$  与  $p_\Lambda$  不仅与温度有关，而且与一定温度下的物质结构有关。因此所有解该方程的学者们不得不简化和加进许多限制条件以求解出方程。但是自由绝热状态下的物质粒子团只会增加熵而降温膨胀，这表明任何时候物质粒子的热压力都超过其引力。只有当其内部的剩余热量流出到外界后，该团物质才会收缩。因此，假设任何一团物质粒子会收缩本身就是与物理真实相违背的伪命题。该团物质粒子能够收缩成为“奇点”的充分必要条件必须是该团物质在任何条件下都能将内部热量排除除去，而这是不可能的。特别是物质团被压缩成为黑洞后，因黑洞无法向外排出热量，内部的物质就更不可能靠其自身的引力继续收缩，更绝无可能收缩为“奇点”。所以“奇点”是广义相对论学者们在解方程时违背热力学规律的假设所造成的恶果。



**《7》。我们宇宙本身和其内部任何物质物体的结构的稳定存在都是在一定温度的条件下，其内部的引力和斥力相对平衡的结果。**所以广义相对论方程中只有引力而无斥力是违反我们宇宙和其内部物质结构稳定存在的普遍规律的，也就是违反热力学定律和因果律的。

第一：宇宙中任何小于  $10^{15}$  克的物体，其中心不一定有一个较坚实的核心，因为该物体本身的化学结构就可以对抗自身的引力塌缩。但是质量大于  $10^{15}$  克的行星，恒星，致密天体，星团，星系等等，**其中心一定存在着对抗其自身引力塌缩的密度较高而较坚实的核心。**地球和行星的中心有坚实的铁质流体或固体。太阳和恒星的中心有提供高温的核聚变坚实中心对抗中心外的物质的引力塌缩。白矮星的中心有密度约  $10^6 \text{g/cm}^3$  的电子简并的坚固核心。中子星和约 3 倍太阳质量的恒星级黑洞，其中心有密度约  $10^{16} \text{g/cm}^3$  的中子简并的坚固核心，它由固体中子或者超子组成。每个星系的中心都有密度较大的巨型黑洞。

第二：在我们宇宙内，最实际的关键问题是，**现在我们宇宙中所能产生的最大压力是强烈的超新星爆炸。**而这种压力也只能将物质粒子压缩到约  $10^{16} \text{g/cm}^3$  的高密度，而形成恒星级黑洞，但还不能破坏质子中子的结构，将其压垮。估计物质粒子的密度达到  $10^{33} \text{g/cm}^3$  才能压垮中子（质子），而压垮夸克的物质密度估计应达到  $10^{92} \text{g/cm}^3$ 。<sup>[1]</sup>宇宙中恒星级黑洞的内部因无可能再产生超新星爆炸，靠黑洞内部物质本身的引力收缩不可能克服质子和夸克的泡利不相容斥力的对抗。因此，更绝无可能塌缩出无穷大密度的“奇点”。

第三：因为爱因斯坦在 1915 年建立广义相对论方程时，只知道 4 种作用力中的 2 种，即引力和电磁力，而不知道尚有弱作用力和强作用力（核力）。当大量的物质粒子因引力收缩而密度增大到相当高时，它们的弱力，电力和核力所构成坚实的物质结构对引力收缩的对抗作用会随着密度的增大而显现出来。这就是上面所说的靠大量物质自身的引力收缩是不能压垮这些力所构成的物体的坚实结构的。

**《8》。原先只有 2 项的广义相对论方程实际上是一个动力学方程，它在什么样的条件下能够得出较准确的结果？即其有效的适用范围是什么？**为什么水星近日点的进动，光线在太阳引力场中的偏转会成为广义相对论方程较准确的验证？一个不加任何限制条件的广义相对论方程能解出来吗？

如果用广义相对论方程研究我们宇宙视界范围以内的宇宙或者宇宙中的某一足够大的区域或定量物体  $M$  时（在忽略其内部温度改变的条件下），这应该能够得出其外部较近的物体或粒子  $m_s$  所作的较准确的沿测地线的运动轨迹。因为在一定量物质场  $M$  的能量-动量张量的作用下，可以看作与其内部为恒温（然而在实际上， $M$  内部的温度会影响其外围尺寸  $R$  的大小，从而影响  $m_s$  运动的曲率半径），因此，在描述  $M$  外的较近的粒子  $m_s$  沿爱因斯坦张量的时空几何特性作测地线运动时，而能得出比牛顿力学较准确的结果。至于较远的  $m_s$  的粒子运动轨迹，则完全可用牛顿力学解决，因为  $M$  中粒子分散的广义相对论效应的影响会减小到可忽略。

1\*。比如，当解决水星近日点的进动时，广义相对论方程之所以能够得出比牛顿力学较准确的计算数值，是因为牛顿力学将太阳质量  $M_0$  当作集中于中心一点来处理的。而广义相对论是将  $M_0$  的质量当作分布在其太阳半径  $R_0$  的转动球体内的。这就使得同等的  $M_0$  对水星引力产生差异。这就是广义相对论方程对牛顿力学的修正，和比牛顿力学较准确的原因。还可能考虑粒子绕中心的旋转。

2\*。当光线在太阳附近的引力场外运动发生偏转时，因为已经按照狭义相对论，规定了光子没有引力质量，而将太阳作为恒温定直径球体，所以光线只能按照广义相对论的解释，在太阳外围作较准确测地线运动。**这是牛顿力学无法解决的问题。但是，如果不按照狭义相对论的观点，而假设光子也有相当的引力质量，用牛顿力学解决光线在太阳外围附近的偏转运动也是有可能的。**

结论：广义相对论对以上 2 个问题的解决之所以能够得出较正确的结果，主要原因在于：A；水星和光线都是在太阳  $M_0$  附近的外面运动，因此，在解方程时可以将  $M_0$  当作恒温的状态（即不是正在收缩或膨胀的状态）来处理。B；既然  $M_0$  是在一定（恒温，表明  $M_0$  中的粒子此时并未正在向奇点塌缩）温度下（核聚变供热）的稳定状态，就可以忽略温度改变对  $M_0$  本身所能造成的影响和改变。这就使得水星和光线在太阳  $M_0$  的外面能有较准确的测地线运动。

**《9》。如果限定我们宇宙视界内的质量  $M_0$  在温度恒定不膨胀，就可用广义相对论方程研究我们宇宙视界外附近的物质粒子  $m_s$  沿测地线的运动，但因我们无法观测到宇宙视界之外的物体运动，所以这对我们毫无意义。**

**《10》。当用广义相对论方程研究宇宙内部或者宇宙内部分区域或物体的（比如星系或者星体）内部运动状况时，因为假设只有纯粹的物质引力，**

而无内部斥力（这些斥力包括有引力收缩时所产生的物质分子的热抗力，物体的结构抗力，核聚变的高温热抗力和物质粒子间的泡利不相容斥力等）与其引力相对抗，即所谓的“零、恒压宇宙模型”。所以任何物体或者粒子团在其内部只有引力收缩的条件下，就只能一直塌缩成为荒谬的“奇点”。这就是 R·彭罗斯和霍金必然会得出的结论。因此，将无宇宙常数的广义相对论方程应用于研究宇宙内部和物体内部各处粒子的运动状况时，其内部任何一点的粒子的测地线运动都是很难从方程中解出来的。这是因为物体内部物质粒子在单纯的引力作用下，都处于正在向“奇点”塌缩的不稳定的运动状态过程中。而爱因斯坦 1917 年在忽略温度（实际上是恒温条件）影响的条件下，就其场方程给出了一个稳定态宇宙的解，其实也是处在不稳定的在向“奇点”极缓慢的塌缩过程中。

《11》. 因此，如果要想使广义相对论方程可以用于解决宇宙或其中的某物体内部的运动状态，就必须要在方程的能量-动量张量项内部引入与有引力的每个粒子同时具有如影随形的斥力，即热力。同时还要在物体的中心加入某温度下足够大的坚实核心作为附加条件。即一方面要将热力学与其能量-动量张量紧密的结合在一起，使每一个有引力的物质粒子同时具有上述的内部斥力(热抗力)，另一方面还要知道在不同半径上的温度分布和密度分布（不同的质量），即引力和斥力平衡所形成的物质结构，这样才有可能正确地解出物体结构（核心）外的各处粒子的真实运动状况，并且避免其内部“奇点”的产生。但如此一来，这方程就会变得极其复杂而现在完全不可能解出来。反之，如果已经知道了物质团的内部的温度分布（斥力）和其核心的结构状况，就不需要广义相对论方程了，用流体力学方程即可解决。这就是广义相对论方程到现在为止，除了作为一种宇宙观之外，而没有得出许多具有普遍性的科学结论的根本原因。由于解方程时提出的许多简化前提，反而得出许多的谬论，如“奇点”。

《12》. 广义相对论方程中本无斥力，所以无法解释宇宙膨胀。而有排斥力的宇宙常数  $\Lambda$  是爱因斯坦后来加进方程中去的。 $\Lambda$  是加在具有引力物质粒子团的外部，而不是能量-动量张量的内部，所以  $\Lambda$  的作用在本质上只能引起该物体（物质粒子团）的外在运动，而无法从广义相对论方程解出物体内部质点的运动轨迹，即测地线。因此，从理论上讲，只有  $\Lambda$  进入能量-动量张量项的内部，使其内部的每一个粒子具有确定的引力和斥力，

才能从该方程中解出物体内部各处粒子的测地线运动。但这种广义相对论完整体系的数学方程尚未建立。

《13》. 因为黑洞在其视界半径  $R_b$  上的状态参数 ( $M_b, R_b, T_b, m_{ss}$ ) 只与黑洞质量  $M_b$  有关，而  $M_b$  的量是与黑洞内部的状态和结构无关的。因此，在解决黑洞本身的生长衰亡问题时，就无需使用广义相对论方程解决黑洞内部结构、状态参数的分布、粒子的运动等问题。而这些黑洞的内部问题只能用牛顿力学、热力学和结构力学等分别予以解决。实际上，解广义相对论方程的过程，也就是将广义相对论方程分解、简化、还原为牛顿力学、热力学和结构力学等的过程。所以，广义相对论方程除了作为时空统一观有重大的意义外，它没有什么特别重大的功能，也就是说，它既不能将牛顿力学、热力学、结构力学和量子力学等综合统一起来，也解决不了分别为牛顿力学、热力学、结构力学和量子力学等所无法解决的问题。所以，实际上场方程是近代科学上的一个花瓶工程，好看不管用，因为它对物体物质的结构和状态及其转变过程没有提出什么新的观点和变化方程。反而使人们在解方程时，为简化而提出许多违反热力学和真实世界的假设，造成出现“奇点”的重大谬误。

《14》. 推而广之，任何现在物理学家所热心研究的各种终极理论，如 T.O.E (Theory Of Everything), 弦论, 膜论等, 如果不与热力学效应联系在一起, 不可能成功而有普适的意义。据作者推论, 当物质密度达到  $\leq 10^{53} \text{g/cm}^3$  时, 即当自由夸克结合成质子后, 此时热效应由于熵的增加 (成为非理想过程) 必然会更加强烈, 这种不可忽视的热压力就造成一团绝热物质粒子的自由膨胀。在密度  $\geq 10^{53} \text{g/cm}^3$  能量-物质范围内, 即自由夸克以至普朗克领域, 是等熵的理想过程, 高温高密度所产生的高热抗力应该就是泡利不相容原理的表现吧。<sup>[1]</sup>

还必须指出的是, 由于广义相对论方程中的粒子都是点结构, 由于粒子质量不可能为 0, 当空间无限缩小时, 必然会出现密度为无限大的‘奇点’。这说明连续的数学方程在极限情况 (临界状态) 下不能描绘物质世界真实的不连续状态。现在的弦论膜论等的基元都非点结构, 自然能从数学上避免在无限小的情况下出现‘奇点’, 但是否是真实物理世界的描写呢? 因为人类也许永远无法观测微观的普朗克领域的真实情况, 那世界是受测不准原理的限制的。因此, 这些弦论膜论终极理论等可能都只不过是些高超的复杂的数学游戏而已。物理世界的物质结构和运动变化方式本来应该是简单的, 但因为没有找到简单合适的

描写他们的数学公式而变得极其复杂而不可理解。

===全文完===

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**Queries about The Equation of General Theory of Relativity---- 《Part One》**

**==No Heat resistances to Balance The Gravitations of Particles In The Item of Energy-momentum Tensor Can Be The Incurrigible Defect of The Equation of General Theory of Relativity (EGTR)==**

Zhang Dongsheng 张洞生

Email: [zhangds12@hotmail.com](mailto:zhangds12@hotmail.com); [zds@outlook.com](mailto:zds@outlook.com); 7/18/2013.

**【Abstract】**。 This article aims to demonstrate that, EGTR could have the incurrigible defect. It is the most important problem for EGTR would have no the heat resistances on the particles to balance its gravitations in the item of energy-momentum tensor of EGTR. Thus, EGTR would certainly be a disequilibrium equation, and violate the thermodynamic laws, and finally lead to the appearance of Singularity in our Universe.

[Zhang Dongsheng. **Queries about The Equation of General Theory of Relativity---- 《Part One》 ==No Heat resistances to Balance The Gravitations of Particles In The Item of Energy-momentum Tensor. Can Be The Incurrigible Defect of The Equation of General Theory of Relativity (EGTR)==**. *Academia Arena* 2013;5(7):35-39] (ISSN 1553-992X). <http://www.sciencepub.net/academia>. 5

**【Key Words】**。 The equation of General Theory of Relativity (EGTR); The incurrigible defect in EGTR; EGTR can violate the thermodynamic laws; Singularity

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**【6】。 对广义相对论方程的质疑——《2》。**  
**====为何解广义相对论方程会得出“奇点”、弗里德曼模型和史瓦西度规等结论都背离实际？====**

张洞生

[zhangds12@hotmail.com](mailto:zhangds12@hotmail.com); [zds@outlook.com](mailto:zds@outlook.com)

**【内容摘要】**：1\*。广义相对论方程 100 年来之所以解决实际问题极少，特别是在宇宙学和黑洞理论方面几乎没有建树，反而带来了许多背离实际的问题，除了在前文论证了<广义相对论方程的根本缺陷是没有热力学效应，既无热力以对抗引力>之外，<sup>[6]</sup> 本文的目的在于进一步指出后来的学者们为了想从复杂得无法解出的广义相对论方程中，解出某些特殊的近似解，就必须在解场方程前，提出各种简化的、不符合物理世界真实的、违反热力学定律假设前提和条件，如均匀性、封闭系统、零压（等压）模型等。但他们的假设条件愈多，出现的错误就愈多愈大，必然使他们解出的场方程的特殊解导致更多的荒谬结论。场方程存在的严重问题，除了没有粒子本身的热抗力之外，还普遍地假定场的均匀性和恒质-能量封闭系统，以便使一个局部的场方程的解无条件地推广到适用于广大的整个系统甚至宇宙。广义相对论方程还有一个最大的矛盾就是：一方面承认质量-能量互换和守恒定律，一方面又否定辐射能有相当的引力质量，人们会问，场方程中如何体现出能量-质量等价互换和守恒定律呢？就是说，物质粒子和辐射能的运动轨迹（测地线运动）如何有序地、有效地统一在场方程中的呢？辐射能和物质粒子是如何一起收缩成为黑洞而后又成为‘奇点’的呢？最近有证据显示宇宙实际上是多宇宙的开放系统<sup>[9][11]</sup>，只能普遍遵守能量-质量等价互换和守恒定律。因此，在那些不合实际的假设条件下，想要用场方程解决宇宙学和黑洞问题，只能错误百出。所以场方程实际上就是一个好看而无大用途的花瓶。本文最后总结了场方程与黑洞理论的重大区别。本文还将在下面具体地分析弗里德曼模型、史瓦西度规和 TOV 方程，看看学者们在解场方程时，除了上述假设条件外，他们还加进了什么不当的前提条件，所得出的一些特殊解又有什么错误结论？2\*。**科学研究的结论和结果取决于所用的理论和研究方法。不同的理论和研究方法会得出不同的结果和结论。但是不同理论、数学公式的结论的正确与否只能根据真实的观测和实验的结果予以确证。**作为与广义相对论方程的对比和当做范例，作者简单地用黑洞理论及其公式解决了一些宇宙学中的重大问题。黑洞理论之所以有效地符合实际，是因为它综合采用了各种近代科学理论的基本公式，而无需任何另设的假设条件，所以其结果能很好地符合客观世界的实际情况。不像解复杂的场方程，需要设立诸多违反热力学定律的简化条件作为前提，才能解出某些特例，但其结果往往成为不切实际的谬论。**霍金黑洞理论的优越性就在于将黑洞视界半径  $R_b$  上的物理状态始终与热力学和量子力学联系在一起，从而证实我们宇宙的生长衰亡规律符合黑洞的理论和规律。**热力学定律是宇宙中最根本的规律，是因果律在物理学中的化身。任何普遍（适）性的新物理理论，如弦论，膜论 T.O.E (Theory Of Everything)等，如果无视热力学定律，必然难以成功。只有用霍金的黑洞理论才能将宇宙产生的膨胀和收缩等的规律予以正确的论证。作者新发展出来的黑洞理论只研究在其视界半径上的各种物理量（参数）的变化，与其内部结构、状态和物质密度的分布等无关，而只取决于黑洞总能量-质量  $M_b$  的值。结果，黑洞最后只能收缩成为最小黑洞  $M_{bm} = (hc/8\pi G)^{1/2} = 10^{-5} \text{ g} = m_p$ ，即普朗克粒子时，就在普朗克领域解体消失。这就无需解复杂的广义相对论方程，无需为解复杂的场方程而设立许多假设前提，以致最终产生“奇点”和许多其它的荒谬结论。<sup>[1]</sup>(附注：本文只分析场方程背离真实物理世界的问题，不涉及诸如惯性质量与引力质量等同性和所有参照系的等效性之类的抽象原理)爱因斯坦的时空统一观是一大飞跃的进步，但广义相对论方程是否符合客观世界地描绘了他的观点呢？

[张洞生. 对广义相对论方程的质疑——《2》====为何解广义相对论方程会得出“奇点”、弗里德曼模型和史瓦西度规等结论都背离实际？====。Academia Arena 2013;5(7):40-49] (ISSN 1553-992X). <http://www.sciencepub.net/academia>. 6

**【关键词】**：广义相对论方程；奇点；弗里德曼方程和 R-W 度规；史瓦西度规；黑洞；黑洞的霍金量子辐射  $m_{ss}$ ；普朗克粒子  $m_p$ ；最小黑洞  $M_{bm}$

**【前言】**。霍金黑洞理论与广义相对论方程在研究宇宙学中的对比。

《0—1》：霍金黑洞理论的简单正确和普适性。

下面是作者对霍金黑洞理论的新发展，会证明任何黑洞只因吞噬外界能量-物质而膨胀，又因发射霍金辐射  $m_{ss}$  最终只能收缩成为最小黑洞  $M_{bm} \equiv$  普朗克粒子  $m_p = m_{ss} = (hc/8\pi G)^{1/2} = 1.09 \times 10^{-5} \text{ g}$  而解

体消失在普朗克领域，而不是收缩成为密度为无限大的‘奇点’。<sup>[1]</sup>

黑洞 4 参数  $M_b$ ,  $R_b$ ,  $T_b$ ,  $m_{ss}$  在黑洞视界半径  $R_b$  上的守恒公式，4 参数的变化规律决定了黑洞生长衰亡的命运。下面是著名的霍金黑洞的温度公式，

$$\underline{M_b T_b = (C^3/4G) \times (h/2\pi\kappa) \approx 10^{27} \text{gk}^{[1]}} \quad (1a)$$

$M_b$ —黑洞的总质能量； $R_b$ —黑洞的视界半径， $T_b$ —黑洞的视界半径  $R_b$  上的温度， $m_{ss}$ —黑洞在视界半径  $R_b$  上的霍金辐射的相当质量， $L_p$ —普朗克长度； $T_p$ —普朗克温度； $R_{bm}$ ,  $T_{bm}$  分别是最小黑洞  $M_{bm}$  的视界半径  $R_{bm}$  和视界半径上的温度  $T_{bm}$ ； $h$ —普朗克常数 =  $6.63 \times 10^{-27} \text{g}\cdot\text{cm}^2/\text{s}$ ， $C$ —光速 =  $3 \times 10^{10} \text{cm/s}$ ， $G$ —万有引力常数 =  $6.67 \times 10^{-8} \text{cm}^3/\text{s}^2\cdot\text{g}$ ，波尔兹曼常数  $\kappa = 1.38 \times 10^{-16} \text{g}\cdot\text{cm}^2/\text{s}^2\cdot\text{k}$ ，

$m_{ss}$  既然是黑洞的量子辐射，就是在视界半径  $R_b$  上的  $m_{ss}$ ，按引力能转换为辐射能的熵温公式， $m_{ss} = \kappa T_b / C^2$  <sup>[2]</sup> (1b)

$$\text{再根据史瓦西对广义相对论方程的特殊解，} \\ \underline{GM_b/R_b = C^2/2}^{[1][10]} \quad (1c)$$

从 (1a) 和 (1b)，极易得出一个重要的如下公式，

$$\underline{m_{ss} M_b = hC/8\pi G = 1.187 \times 10^{-10} \text{g}^2} \quad (1d)$$

既然  $m_{ss} M_b$  为常数，根据热力学第三定律，必定有  $T_b \neq 0$ ，而且  $T_b$  也不可能为无限大。因此，就可得出  $m_{ss} \neq 0$ ,  $M_b \neq 0$ ，因而  $m_{ss}$  和  $M_b$  及其密度  $\rho_b$  都不可能是无限大和零。就是说， $m_{ss}$  和  $M_b$  都必定有个极限。同样，按照(1a)、(1b)、(1c)式， $T_b$ 、 $R_b$  也都不是无限大和零，都必定有个极限。再根据部分不可能大于全体的公理。这个极限就是最大的  $m_{ss}$  必定等于最小的  $M_{bm}$ ，即是  $M_b = M_{bm} = m_{ss}$ 。从(1d)可得，再从量子引力论得知  $(hC/8\pi G)^{1/2} = m_p =$  普朗克粒子，<sup>[3][11]</sup>于是，黑洞  $M_b$  最后只能收缩成为最小黑洞  $M_{bm} = m_p$ ，即

$$\underline{m_{ss} = M_{bm} = hC/8\pi G}^{1/2} = m_p = 1.09 \times 10^{-5} \text{g} \quad (1e)$$

公式 (1d) 和 (1e) 都是作者新得出的黑洞在视界半径  $R_b$  上普遍有效的公式。

于是有： $R_{bm} \equiv L_p$  <sup>[3]</sup>  $\equiv (Gh/2\pi C^3)^{1/2} \equiv 1.61 \times 10^{-33} \text{cm}$

$$T_{bm} \equiv T_p$$
 <sup>[3]</sup>  $\equiv 0.71 \times 10^{32} \text{k}$

最小黑洞  $M_{bm}$  的康普顿时间 Compton time  $t_c =$  史瓦西时间  $t_s$ ， $\rho_{bm}$  是  $M_{bm}$  的密度、于是，

$$t_c = t_{sbm} = R_{bm}/C = 1.61 \times 10^{-33}/3 \times 10^{10} = 0.537 \times 10^{-43} \text{s},$$

$$\rho_{bm} \approx 10^{93} \text{g/cm}^3 \quad (1f)$$

从  $M_b = 4\pi\rho_b R_b^3/3$  和 (1c)，对于任何一个黑洞，下面的(1g)总是有效的。

$$\underline{\rho_b R_b^2 = 3C^2/(8\pi G) = \text{constant}} \quad (1g)$$

结论：1\*；上述证明完全是成功地利用了现有的各种科学理论的基本公式，没有什么假设前提。2\*；以上的各公式证明，黑洞并不是一个孤

立系统，而是一个开放系统，它因吞噬外界能量-物质或与其它黑洞碰撞合并而膨胀，以增长其质量  $M_b$  和视界半径  $R_b$ 。在它吞噬完外界的能量-物质后，立即不停地向外发射霍金辐射  $m_{ss}$  而收缩，以减少其  $M_b$  和  $R_b$ ，直到最终收缩成为  $M_{bm} = (hC/8\pi G)^{1/2} = m_p = 1.09 \times 10^{-5} \text{g}$  而解体消失在普朗克领域，而不可能收缩成为‘奇点’。<sup>[1]</sup> 3\*；黑洞是宇宙中最简单的实体，其 4 参数  $M_b$ ,  $R_b$ ,  $T_b$ ,  $m_{ss}$  之间只有简单的单值关系，一旦其中一个的值被确定后，其它的 3 个也跟着被上面的所确定了，而每个参数的值都只被 4 个自然常数  $G$ ,  $C$ ,  $h$ ,  $\kappa$  的不同关系所决定。<sup>[1]</sup> 4\*；由于霍金黑洞理论是建立在热力学和量子力学的坚实基础之上的，所以黑洞的收缩只与其  $M_b$  的量有关，而与黑洞内部  $M_b$  的成分结构和运动状态无关。因此无需知道黑洞内部的能量-质量的密度分布，温度分布、运动状态等等复杂问题，就可极其容易地得出黑洞最终收缩成为普朗克粒子  $m_p$  的准确结论。而广义相对论方程及其解的许多错误的、违反热力学的假设只能导致许多荒谬的结论。5\*；我们宇宙是一个真实的宇宙巨无霸黑洞。<sup>[1]</sup>

#### 《0-2》。广义相对论的复杂性和缺陷

1917 年爱因斯坦首次就其场方程给出了一个假稳定态宇宙的特殊解，

由于下面的广义相对论方程(2a)是非线性的引力场方法，太复杂，无法解出一般解。用爱因斯坦的话说，该方程完美到无法加进去任何东西。因此，该方程只有最后归结为理想的、连续地恒定(定能量-质量，零压)流，才可能在再假设其它的附加条件下，得出少数特殊解。所以，所有后来解该方程的学者们都提出了许多简化的假设条件。其中都有几个共同的假设，或者说先决条件；第一；宇宙学原理，即密度均匀性。第二；零压(等压)宇宙模型，即一团能量-物质收缩或者膨胀时，时空的变化仅由引力引起，不考虑热压力改变的影响。第三；在时空的变化整个过程中，都保持同等的能量-物质质量，既无排出，也无吸入(孤立系统)。第四；根本不认为大质量物体中心有高密度的坚实核心能够对抗自身的引力塌缩。正是这些错误的、不合实际的假设，使所有得出(2a)的特殊解，如弗里德曼(Freidmann)方程、R-W 度规(Robertson-Walker metric)和史瓦西度规等都不合乎宇宙中的实际情况，因而得出许多荒谬的结论，如‘奇点’。

下面先从广义相对论方程谈起。以论证等量粒子团绝无可能塌缩出无穷大密度的“奇点”。

$$G_{\mu\nu} + \chi T_{\mu\nu} + \Lambda g_{\mu\nu} = 0^{[3]} \quad (2a)$$

上面(2a)式就是爱因斯坦广义相对论方程一场方程，该方程原来只有左边的 2 项。引力场方程是

非线性的，不加假设条件，无法求出其一般解。 $G_{\mu\nu}$  是描述时空几何特性的爱因斯坦张量。 $T_{\mu\nu}$  是物质场的能量-动量张量。 $g_{\mu\nu}$  是度规张量。不幸的是，这样的模型与广义相对论的初衷是不相容的。这一点从物理上讲很容易理解，因为普通物质粒子间的引力是一种纯粹的相互吸引的中心力，而在纯粹吸引力作用下的物质分布是不可能达到静态平衡的，只能向其中心收缩。为了维护整个宇宙的“宁静”，Einstein 后来不得不忍痛对自己心爱的广义相对论场方程作了修改，增添了一个所谓的“宇宙学项” $\Lambda g_{\mu\nu}$ ，其中  $\Lambda$  被誉为宇宙学常数。 $\Lambda g_{\mu\nu}$  具有排斥力，它是爱因斯坦为了保持宇宙中引力和斥力的平衡后来才加进去的。<sup>[3]</sup>

1917 年爱因斯坦就其场方程给出了一个稳定态宇宙的解，即宇宙半径  $R$  不随时间的变化，

$$\begin{aligned} \text{令 } \chi &= 8\pi G/C^4, \Lambda \text{ 可以取为,} \\ \Lambda_c &= 64\pi^2/(9\chi^2 M^2) \quad [3] \quad (2b) \\ \text{而 } R_c &= \Lambda_c^{-1/2} \quad [3] \quad (2c) \end{aligned}$$

后来，勒梅特(Lemaitre)指出，爱因斯坦的解是不稳定的。1927 年他从(2a)式中得出  $R$  必须满足下面的两个方程(2d)和 (2e)。<sup>[3]</sup> 下面  $K$  是空间曲率。

$$4\pi R^3 \quad 3 = M = \text{Const} > 0 \quad [3](2d)$$

得出， $(dR/dt)^2 = 2GM/R + \Lambda R^2/3 - KC^2$  <sup>[3]</sup> (2e)

从(2e)可看出，当  $\Lambda=0$  时，只要给出的  $R$  受到任何的微扰，即  $dR/dt$  一旦不为零，它就会随着时间的改变，宇宙或者膨胀，或者收缩，总是处在加速或减速运动的状态中。其解的结果是与爱因斯坦的初衷自相矛盾的。

《0-3》。分析和结论：因解广义相对论方程的各种假定都背离实际，解方程的结果必然错误。场方程作为时空统一的一种宇宙观可能有重大的意义，但不可能通过解场方程来定性定量地解决宇宙学中的任何问题。弗里德曼模型无法解释宇宙膨胀，史瓦西度规导致宇宙收缩成为‘奇点’谬论。下面作一些具体分析。

1\*；1917 年，还没有宇宙膨胀的哈勃定律，爱因斯坦在解场方程时，只有在假定了  $M =$  常数、宇宙为孤立系统、宇宙密度  $\rho =$  常数的情况下，才勉强解出了一个看似  $dR/dt =$  常数的稳定解。而实际上  $dR/dt$  因实际宇宙中的  $M, R, \rho$  不等于常数，而不稳定。

现代宇宙学中通常把宇宙学项并入能量动量张量，这相当于引进一种能量密度为  $\rho_\Lambda = \Lambda/8\pi G$ ，压强为  $p_\Lambda = -\Lambda/8\pi G$  的能量动量分布，这种十分奇特的能量动量分布，使广义相对论方程有所改进。在广义相对论中，当能量密度与压强之间满足  $\rho+3p<0$  时，能量动量分布所产生的“引力”实际上具有排斥作用。因此在一个宇宙学常数  $\Lambda > 0$

的宇宙学模型中存在一种排斥作用，这种排斥作用与普通物质间的引力相平衡，使得 Einstein 成功地构造出了一个静态宇宙学模型，其宇宙半径为  $R = \Lambda^{-1/2}$ ，即前面的公式 (2c)。<sup>[12]</sup> 这说明宇宙膨胀到密度很小的低温情况下，粒子的热斥力也是不可忽略的。只有将高温高密度下粒子的热抗力加进场方程，才能得出较符合实际的结果，但谁能解出这样一团粒子的场方程呢？

2\*；就是说，要想解决场方程，首先要解决场方程中  $M, R, \rho, T$  各个数不等于常数的问题，更难解决的问题是在场方程中解决  $M(R), T(R), \rho(R)$  在  $R$  上的分布问题。谁有能力在不提简化假设的条件下能解出如此复杂的场方程呢？

3\*；大量定量的物质-能量粒子团为什么会引力收缩？按照热力学定律，它只有向外排出部分具有热能的辐射才会收缩。这就是通俗称之为物体或粒子团热胀冷缩的道理。<sup>[6]</sup> 大家都知道将氮压缩成液体氮的过程，只有一面用冷却方法不断地排出氮里的热量，一面加高压，氮才能被压缩成液态氮。因此，场方程首先就假定其对象的能量-物质总体为常数，这本身就是违反实际、违反热力学规律的，即使场方程被解出来了，其结果也必然是错误的。

4\*。宇宙为什么会降温膨胀？从宇宙膨胀的热力学的理论，根据经典理想过程的热力学关系式，随着宇宙尺度因子  $R$  的增大，物质粒子的温度  $T_m$  与宇宙尺度因子  $R$  的平方成反比，而辐射能的温度  $T_r$  则与宇宙尺度  $R$  的一次方成反比（证明见参考文献[3]从略）<sup>[3]</sup>。其暗中的假定是宇宙的膨胀或收缩都是均匀的。即得出，

$$T_r \propto 1/R \quad [3] \quad \text{或者 } R_{r1} T_{r1} = R_{r2} T_{r2} \quad (2f)$$

$$T_m \propto 1/R^2 \quad [3] \quad \text{或者 } R_{m1}^2 T_{m1} = R_{m2}^2 T_{m2} \quad (2g)$$

从上面 2 式可见，当宇宙温度从  $T_{r2}=T_{m2}$  降温到  $=1/10 \times (T_{r1}=T_{m1})$  时，辐射能膨胀了 10 倍， $R_{r2}=10R_{r1}$ ，而物质粒子团只膨胀了 3.16 倍，即  $R_{m2}=3.16R_{m1}$ 。可见，当宇宙绝热膨胀降温时，辐射能的膨胀比物质粒子的膨胀快的多得多。从另一角度看，就是粒子团相对地收缩了约 70%，这就是宇宙因辐射能必须降温才能膨胀以造成物质粒子团的引力收缩成为星系和恒星、而后才会有人类出现的原因。

可见，实际的宇宙中既有辐射能的膨胀，又有物质粒子在膨胀中的相对的收缩（少膨胀），由于辐射能为宇宙中总质能的 74%，物质粒子只有 26%。<sup>[11]</sup> 所以宇宙的膨胀主要表现为辐射能的膨胀。请问有无高手能够解出一个定量能量-物质粒子团一面向外排热一面向收缩的一个统一的场方程呢？

5\*；当一团能量-物质粒子团一面向外排热一面引力收缩，而收缩到一定程度、其中心温度达到约  $1.5 \times 10^6 \text{K}$  时，必然产生氢转变为氦的核聚变，其高温核心就能对抗其外围物质引力塌缩。当核聚变完成后，经过超新星爆炸，爆炸的内压力能将其中心残骸压缩或成为白矮星、或中子星、或小于  $3M_{\odot}$  太阳质量的小黑洞。这种塌缩成黑洞的实际过程是场方程无法描述解决的。

6\*。于是一些大学者们头脑一发热，就既假定一个能量-物质粒子团不向外排热而收缩，又假定它的收缩不产生核聚变，直接塌缩成为黑洞，再又假设该黑洞内外可用同一个连续方程，于是宣布最后会塌缩成为荒谬的、宇宙中找不到的、密度为无限大的‘奇点’。

就算一个大量能量-物质粒子团不经过核聚变可以直接收缩成为一个小黑洞。当黑洞形成时，组成黑洞的那部分能量-物质粒子也会有一个大塌缩。比如在宇宙中形成一个  $M_{\text{bs}} = 3M_{\odot} = 6 \times 10^{33} \text{g}$  的恒星级黑洞，其视界半径会塌缩成  $R_{\text{bs}} = 9 \text{km}$ ，其密度  $\rho_{\text{bs}} = 2 \times 10^{15} \text{g/cm}^3$ 。就是说，在黑洞视界半径  $R_{\text{bs}}$  的内外，是 2 个完全不同的世界，外面的密度  $\rho_{\text{u}} = 10^{-29} \text{g/cm}^3$ ，二者的密度相差  $\rho_{\text{bs}}/\rho_{\text{u}} = 10^{45}$  倍。此外，黑洞内外的温度、结构、物理状态和运动形式等等也是完全不同的、是不连续的。因此，怎么可以用黑洞形成前的同一个方程（度规）来描述黑洞形成后的、黑洞内外的状态及其运动的结果呢？

7\*。黑洞形成后，内外密度  $\rho_{\text{u}}$  与  $\rho_{\text{bs}}$  差别如此之大，一些大学者们，玩弄数学游戏，故弄玄虚，用史瓦西度规来解释，说什么黑洞形成后，内部时空颠倒，其中心  $R = 0$  的点成为时间的终结，以后会成为时间之外。又说，那里是有无穷大密度的‘奇点’，时空弯曲成无穷大。黑洞内部的空间是真空，认定奇点是黑洞存在的前提。<sup>[7][8]</sup> 再看看真实的宇宙，我们宇宙空间有许许多多恒星级黑洞，有不少孤单单的黑洞在宇宙空间游荡，如果这些黑洞中心真有‘奇点’，这些‘奇点’为什么不产生出人类能够感觉到的大爆炸，不爆炸出新宇宙来呢？

8\*。但是，第一；因为黑洞强大的引力使其内部的辐射能量无法排出到外界，其热抗力是对抗粒子无法靠其自身的引力而收缩的，就更毫无可能收缩成为‘奇点’，这是简单的热力学定理。第二；黑洞内部能量-物质的引力都是集中力，指向中心，这没有错。但是每个大物体的质量  $> 10^{15} \text{g}$  的物体，之所以能够承受其外围物质引力的塌缩，因为其中心都有更高密度的核心（物体质量  $< 10^{15} \text{g}$  者，其物质结构能够承受自身的引力塌缩），如地球有铁质的核心，太阳有核聚变的高温核心。

中子星和恒星级黑洞中心有密度约  $10^{16} \text{g/cm}^3$  的超子或固体中子，而夸克的密度可以高达  $10^{22} \text{g/cm}^3$ 。<sup>[1]</sup> 第三；作者已经证实，我们宇宙就是一个真实的巨无霸黑洞。<sup>[1]</sup> 我们人类就居住在这个黑洞里，我们为什么不奔向宇宙黑洞中心的‘奇点’而毁灭呢？

9\*。从(1c)式可知，只有黑洞才能使(2e)式中的  $2GM/R = \text{常数}$ ，而使  $dR/dt = \text{常数}$ 。这就是哈勃定律可适用于黑洞的原因。

下面举出几种模型来分析，指出由于简化解场方程出现的错误都可以从上面的分析中找到原因。

【一】。用弗里德曼(Freidmann)方程 R-W 度规 (Robertson-Walker 度规) 来判断宇宙膨胀或收缩的命运，不仅没有实际的意义，而且提出  $\Omega = \rho_0 / \rho_c \neq 1$  的伪命题困扰科学界近 100 年。《1-1》。弗里德曼(Freidmann)方程和 R-W 度规 (Robertson-Walker metric) 是在符合封闭系统、各向同性的宇宙学原理、“零压宇宙”模型（无热力学效应），和定能量-物质的膨胀条件下推导出来的，它无法解释宇宙的平直性  $\Omega$  为什么会非常接近于 1。因为该模型的根本问题是，在没有热压力对抗引力的情况下，单纯的引力作用是一种非稳定的收缩流。因此，无法找出宇宙真实密度  $\rho_0$  与临界密度  $\rho_c$  的差别。现在从 R-W 度规出发，

$$ds^2 = C^2 dt^2 - dl^2 = C^2 dt^2 - R^2(t) [dr^2 / (1 - Kr^2) + r^2 (d\theta^2 + \sin^2 \theta d\phi^2)] \quad (11)$$

上面(11)中， $R(t)$  仅仅是时间的函数，与坐标无关，在一定的意义下， $R(t)$  可以理解为“宇宙的半径”，决定宇宙究竟是膨胀还是收缩， $K$  是空间曲率，决定于究竟是有限还是无限。(11)中， $r$  所表示的只是测量距离  $l$  与尺度因子  $R$  的比，所以  $r$  并不是观察者 ( $r = 0$ ) 到天体的距离  $l$ ，而是所谓的径向共动距离坐标。<sup>[3]</sup> 在(2e)式中当  $\Lambda = 0$  时，就得到，

$$(dR/dt)^2 - 8\pi G\rho R^2/3 = -KC^2 \quad (11a)$$

$$d^2R/dt^2 = -4\pi G\rho R/3 \quad (11aa)$$

$$(dR/dt)^2/R^2 + 2(d^2R/dt^2)/R = -KC^2/R^2 \quad (11b)$$

(11b) 就是弗里德曼(Freidmann)方程，是弗里德曼直接从爱因斯坦场方程得到的。(11a)和(11b)两式是完全一致的。式(11a)是关于  $R(t)$  的最基本的方程式，还可用 (11aa) 式积分而得，此地  $K$  是曲率， $-KC^2$  是常数。(11b)式是一个典型的微分方程。对应于方程中常数项的不同取值，便得到  $R(t)$  的不同形式的解。这些解分别对应于不同的宇宙模型。在推导该方程时，是忽略了宇宙中压力项的影响的。因此，由该方程给出的宇宙模型都属于“零压宇宙”模型，而且都要符合宇宙学原理等。<sup>[3]</sup> (11a)可改写为，

$$\rho = 3 [(dR/dt)^2 + KC^2]/(8\pi GR^2) \quad [3] \quad (11ab)$$

从(11ab)可看出, 在  $R(0) = 0$  时,  $\rho \rightarrow \infty$ 。所以  $R(0) = 0$  就成为空间“奇点”, 这就是广义相对论得出的宇宙产生于无限大密度的“奇点”结论的根源。无论  $K$  为何值, 该点的空间曲率和密度都是  $\infty$ 。但是(11ab)隐藏着故意人为的诡秘, 见后面。

如果考虑到热压力对引力收缩的对抗, 同时, 如再考虑到任何物体的中心都会出现较高密度的核心对抗其外围物质引力的塌缩, 一团定量的能量物质粒子  $M=4\pi\rho R^3/3 = \text{const}$  就绝无可能由于自身的引力收缩或者极高压的压缩, 能使  $M$  达到  $R=0$  处的  $\rho \rightarrow \infty$ 。因此, 在  $R(0) = 0$  处,  $\rho \neq \infty$ 。就是说,  $R$  能否  $\Rightarrow R(0)$ , 不是一个数学问题, 而应该是真实的物理世界允不允许的问题。数学公式的应用区间应该受真实物理世界的临界上限和下限的限制。世界上还没有一个数学公式在实际中的应用区间可以从  $0 \Rightarrow \infty$  的, 这不符合我们有限宇宙的真实状况。

由(2e)和(11b)式, 可得到符合(2d)式, 即在宇宙总物质  $M = 4\pi\rho R^3/3 = \text{const}$  时,

$$\rho = - (d^2R/dt^2)/4\pi GR = 3 H^2 q/4\pi G \quad [3] \quad (11c)$$

上式(11c)通常将宇宙的物质密度  $\rho$  用哈勃常数  $H$  和减速因子  $q$  来表示。定义一个宇宙的临界密度  $\rho_c$ , 令,

$$\rho_c \equiv 3H_0^2/8\pi G \quad [3] \quad (11d)$$

设宇宙目前的密度值为  $\rho_0$ ,  $H_0$  是宇宙目前的哈勃常数,  $q_0$  是目前宇宙的减速因子。

$$\rho_0 = 3q_0 H_0^2/4\pi G \quad [3] \quad (11e)$$

相应地定义一个密度参数值,

$$\Omega = \rho_0 / \rho_c \quad [3] \quad (11f)$$

广义相对论就是用  $\Omega$  值来判断宇宙的最终命运的。当  $\Omega > 1$ , 即  $\rho_0 / \rho_c > 1$  时, 宇宙是闭宇宙, 闭宇宙是有限的。当  $\Omega < 1$ , 即  $\rho_0 / \rho_c < 1$  时, 宇宙是开宇宙, 开宇宙是无限的, 没有有限半径。当  $\Omega = 1$ , 即  $\rho_0 / \rho_c = 1$  时, 是临界情形, 宇宙是平直的无限宇宙。

上述的标准宇宙模型, 即 FLRW(Freidmann - Lemaitre-Robertson-Walker)模型, 也就是弗里德曼(Freidmann)模型, [3] 这是一个没有考虑热压力(零压宇宙模型)的定质量的纯引力的膨胀模型。它无法解释宇宙为什么会膨胀, 密度为什么会变化。

但按照黑洞理论, 我们宇宙就是一个真实的宇宙黑洞, 其密度  $\rho_c$  有唯一确定值, 它只被宇宙黑洞的总质-能  $M_{bu}$  值所决定。[1] 在实际的测量中, 只能用哈勃定律的  $H_0$  去定出宇宙密度  $\rho_c$ , 无法分辨什么是  $\rho_0$ , 什么是  $\rho_c$ , 这种分别也毫无意义, 因而总会是得出  $\Omega \approx 1$ 。因此, 如用  $\Omega = \rho_0 / \rho_c$  是无法去判别宇宙是封闭还是开放的。这实质上

是一个伪命题, 是为了简化方程而提出上述诸多错误假设而得出的错误结论。

在黑洞理论里, 宇宙黑洞就是个不封闭不孤立的球体, 它只有在吞噬外界质-能时膨胀而降低密度, 在吞噬完外界质-能后, 就不停地发射霍金辐射而收缩, 直到最后收缩成为普朗克粒子而解体消亡。[1]

## 《1-2》。分析和结论:

第一; 上面说过, (11ab)隐藏着故意人为的诡秘, 证实如下。(11ab)和(11a)式可改为(11ac), 就免除了  $R=0$  的人为的  $\rho \rightarrow \infty$ 。

$$\rho R^2 = 3 [(dR/dt)^2 + KC^2]/(8\pi G) \quad [3] \quad (11ac)$$

由于现实中宇宙的膨胀,  $(dR/dt)^2 = V^2 \neq 0$ , 按弗里德曼模型,  $V$  是宇宙的膨胀或收缩的速度。对于一个恒质能量封闭宇宙的总质量  $M = \text{常数} \propto \rho R^3 \propto (V^2 + KC^2)R$ 。所以无论  $V$  和  $K$  为何值, 除了2个特例之外, 其它任何情况,  $R$  和  $(V^2 + KC^2)$  都不可能为 0。所以在  $R=0$  处,  $\rho$  不可能是  $\infty$ 。而使  $V^2 + KC^2=0$  的2特例是: 特例1,  $V$  与  $K$  同时为 0, 这是一个恒质能量静止封闭的等压稳定系统, 系统内只能各处都是  $R=0$ , 所以各处  $\rho = \text{常数} = \text{该系统密度}$ 。特例2,  $K=-1$  时,  $V = \text{光速 } C$ , 这是一个恒质能量的均压的自然开放系统, 在系统内部无排斥力情况下,  $V$  无论膨胀或收缩, 不可能 =  $C$ 。

第二; 作者在《黑洞理论和宇宙学的新进展》[1]一文中已经完全证明, 我们宇宙就是一个真实宇宙黑洞  $M_{bu}$ 。[1]证实了哈勃定律描述的宇宙膨胀就是宇宙黑洞吞噬外界能量-物质或者与其它黑洞碰撞合并而膨胀的规律。并且证明了这就是宇宙密度  $\rho$  因膨胀而降低的原因。[1]

根据(1c)式  $GM_b/R_b = C^2/2$ , 这是史瓦西对方方程球形无电荷无角动量黑洞的特殊解, 再按照球体公式,  $M_b = 4\pi\rho_b R_b^3/3$ , 可得出,

$$C^2 = (8\pi G\rho_b/3)R_b^2; \quad V^2 = H_0^2 R^2; \quad (11ad)$$

由(11ad)式,  $(8\pi G\rho_c/3) = H_0^2$ , 而黑洞视界半径  $R_b$  上辐射能的速度 = 光速  $C$ , 按照宇宙各处均匀膨胀的原理, (11ad)式就是哈勃定律  $V = H_0 R$  式的极限情况。可见, 用黑洞理论就可以简单直接地推导出哈勃定律。

因此, 按照黑洞理论,  $\Omega = \rho_0 / \rho_c \equiv 1$  是宇宙黑洞的本质属性。因为  $\rho_c$  只能被宇宙黑洞的总能量-质量  $M_{bu}$  所唯一的确定。哈勃定律中  $H_0$  的存在正是表示宇宙黑洞  $M_{bu}$  的外界还有能量-物质正被吞噬进来。

等质量等压纯引力的弗里德曼模型根本毫无宇宙膨胀的动因, 将  $dR/dt$  硬说成宇宙可膨胀, 实际上是在牵强附会。弗里德曼宇宙膨胀模型是在哈勃定律发现之前提出来的, 那时用  $\Omega =$



$\rho_c / \rho_c$  是否 = 1 来判断宇宙的开放或者闭合,情有可原。但科学家们现在仍然抱着 80 多年前弗里德曼模型不放,将宇宙黑洞本来就是  $\Omega = 1$  的正确概念置之不理,却让人们糊里糊涂地直到现在还去寻找  $\Omega$  将是否 = 1。这是毫无意义的抱残守缺。

**【二】。史瓦西度规是在解场方程时,假设定量的一大团能量-物质 M 会在其自身的引力作用下,收缩成为黑洞后,再塌缩成为‘奇点’,这结论为什么是错误的?**

《2-1》。史瓦西度规: 广义相对论是只假设恒质量 M 物质的引力收缩在无何对抗力下一直会收缩到‘奇点’,而没有考虑引力收缩时所引起的热压力和高密度核心的对抗。实际上大量质量的 M 最多只能收缩到成为  $M \gg M_b (= C^2 R_b / 2G)$  的黑洞,不可能缩成为  $M = M_b$  的黑洞,更不可能收缩成为‘奇点’。但按照彭罗斯和霍金的解释,在黑洞  $M_b$  形成后的瞬间,黑洞内部突然变成时空颠倒,所有黑洞内的能量-物质一下收缩到中心成为密度无限大的“奇点”,并使黑洞内部空间成为真空。这就是罗杰·彭罗斯和霍金证明后的结论。<sup>[7]</sup> 其解释可根据史瓦西度规,

$$ds^2 = (1 - r_b/r) dt^2 - dr^2 / (1 - r_b/r) - r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2 \quad (12a)$$

《2-2》。主流的广义相对论学者们对(12a)式的错误解释和作者反对的一些看法, 在该式中,  $r_b = 2GM_b/C^2$ ,  $r_b$  是质量  $M_b$  的史瓦西半径。对于太阳质量黑洞,  $r_{bs} = 295\text{cm}$ 。<sup>[4]</sup>

第一. 当  $r_b < r$  时, 即从黑洞外面观察黑洞对外界物质或物体的引力作用时, 因为  $M_b/M = r_b/r$ , 广义相对论者的解释是可以被接受的。因(12a)式与正常的引力质量体无异, 实际上是将黑洞  $M_b$  当作为中心力来看待的。<sup>[4]</sup>

第二. 当  $r_b = r$  时, 按照主流学者对(12a)式的解释, 称为坐标奇点。它可以通过坐标变换而去掉。尽管如此, 它还有许多异乎寻常的性质。当  $r = r_b$  时, (12a)式变为  $ds^2 = 0 \times dt^2 - \infty \times dr^2$ , 这就是说, 在黑洞的视界半径  $r_b$  上, 一个事件无论经过多么长时间  $dt$ , 事件的信息也传不出去, 因为光在  $r_b$  上被禁锢, 不能逃出  $r_b$  之外。他们对(12a)解释是可接受的, 因仍然有  $M_b/M = r_b/r$ 。<sup>[4]</sup>

第三; 当  $r_b > r$  时, 按照学者们对广义相对论的解释, (12a)式变为  $ds^2 = - (r_b/r - 1) dt^2 + dr^2 / (r_b/r - 1) - r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2$ , 因为式中  $dt^2$  为“-”而  $dr^2$  为“+”, 所以得出黑洞内时空颠倒的结论, 而进一步得出黑洞内所有物质塌缩集中到其中心成为“奇点”和“黑洞内为真空”的荒谬结论。这些说法为什么是错误的呢?<sup>[4]</sup>

第四. 学者们对史瓦西度规对(12a)式更进而解释和假设说, 当  $r = 0$  时, 成为内禀奇点。全部质量集中于此点, 密度为无穷大, 时空曲率无穷大, 物理定律失效。<sup>[4]</sup>

上述第三第四是他们按照(12a)式的数学方程而作出的一种无可奈何、先入为主、假设性的错误解释, 也就是一种曲解。他们是假设黑洞内的物质在没有任何对抗力的条件下, 按照单纯的引力收缩必定成为“奇点”而得出的主观结论。按照他们的这种假设, 黑洞外的任何大小的物质粒子团的引力收缩, 即凡是有物质引力存在的地方, 都会塌缩出来“奇点”来。这是错误的假设前提导致必然的错误结果。

《2-3》。作者认为相对论学者们对(12a)式的解释和推理在上面第三第三段是错误的, 理由如下。首先必须指出的是广义相对论学者们解释的 2 个根本性的错误前提:

第一; 首先, 在宇宙中, 任何条件下, 都不可能塌缩出  $M = M_b$  的黑洞, 因为这违反热力学定律。因此, 在实际上, 当一团能量-物质 M 收缩成为黑洞时, 黑洞内的能量-物质  $M_b$  与黑洞内外原来的能量-物质 M 是完全不相等的, 即  $M \gg M_b$ , 而且黑洞视界半径  $R_b$  将黑洞内外严格地区分为 2 个极不相同的世界, 内外的各个物理量都不相同和不连续(可参见前面的《0-3》的 5\*~8\* 节), 密度可以相差到  $10^{45}$  倍。因此, 黑洞内外是不可以用同一个连续方程(12a)式的。因此, 他们用同一个解和度规来连续地描述黑洞内外的时空状况, 必然会得出错误的结论。

第二; 必须指出, 所有广义相对论学者们对(12a)式解释的关键错误在于似乎故意对  $r_b/r$  定义的错误解读。 $r_b/r$  的真实物理意义应是  $r_b$  内的能量-物质  $M_b$  与  $r$  内的能量-物质 M 之比, 即  $M_b/M$ , 在宇宙学原理的均匀性假设条件下, 即在黑洞未形成前和黑洞形成后的外部, 才能有  $M_b/M = r_b/r$ , 才可在(12a)式中可用  $r_b/r$  取代  $M_b/M$ 。

第三; 他们另外一个先入为主的极度错误的假定是, 当黑洞形成后, 假定黑洞内  $r_b > r$ , 造成时空颠倒, 使(12a)式变为  $ds^2 = - (r_b/r - 1) dt^2 + dr^2 / (r_b/r - 1) - r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2$ , 因为式中  $dt^2$  为“-”而  $dr^2$  为“+”, 而得出黑洞  $M_b$  完全集中在黑洞中心  $r_b = 0$  点上, 成为‘奇点’; 黑洞内空间是真空; 黑洞内时空倒转 3 大错误结论。

在黑洞内, 作者认为, 即使按照他们的说法, 物质都已经全部集中于中心成为‘奇点’了, 那么,  $r_b$  与  $r$  内的质能量就是同样的  $M_b$ , 即  $r_b/r = 1$ , 而不是如他们所说的  $r_b/r > 1$ 。所以他们按  $r_b/r > 1$  得出黑洞内时空颠倒的结论是他们掩耳盗铃而得出自相矛盾的结果, 是根本不可能出现

的。其实，他们是在先假设肯定黑洞内能量-物质塌缩成为“奇点”的条件下，来说明黑洞内部“奇性”的出现。

**第四；上述黑洞内所有物质塌缩集中到其中心成为“奇点”的结论之所以荒谬：是 1\*；因为他们不承认黑洞内部粒子有热抗力和密度较大的坚实核心能够对抗自身的引力塌缩。所以(12a)式不能将原来的  $r_b/r$  用于黑洞内。2\*；因为即使假定黑洞中心出现更小的黑洞  $r_{bs}$ ，而要用(12a)式时，(12a)式必须改为  $ds^2 = (1-r_{bs}/r)dt^2 - dr^2/(1-r_{bs}/r) - r^2d\theta^2 - r^2\sin^2\theta d\phi^2$ ，而且必须满足  $r_b > r > r_{bs}$  条件。这样，就不可能得出  $r_b < r$ ，而使(12a)中的  $dt^2$  变为“-”，使  $dr^2$  变为“+”的荒谬结果。**

**第五；如果仅从数学观点来分析(12a)式，也可以作如下解释：在  $r = 0$  处，因  $ds$  只能在  $r_b$  内，此时， $ds^2 = -\infty dt^2$ ，首先的直接的结论应该是  $ds^2$  为负，是虚数，是无意义。即在 0 点，无论  $dr$  或者  $dt$  是“-”或“+”，都与  $ds$  无关，即永远隔绝，所以在  $r = 0$  点的物质质量也只能看作为 0，所以密度  $\rho$  不是  $\infty$ 。最重要的是：在(12a)中，原来的定义为  $r_b < r$ ，在黑洞形成后，突然擅自令  $r_b > (r = 0)$ ， $r$  有什么魔法可自由地在同一公式中由  $\infty$  通过黑洞到  $R=0$ ？**

**第六；如果按照霍金等对广义相对论的解释，黑洞中心已经成为“奇点”，这个无限大密度的“奇点”为什么不即刻大爆炸呢？这种大爆炸如果能破坏黑洞的视界，黑洞就解体消失了，或会变成另外的宇宙了。如果这种大爆炸不能破坏黑洞的视界，就表示黑洞仍然牢不可破，“奇点”在大爆炸后的物质又会按照广义相对论的解释，重新塌缩到中心再次成为“奇点”。这样，黑洞内部就会永远不停地产生反复的“奇点”大爆炸，永远没完没了，真实的物理世界是这样吗？**

**【三】。从物质粒子球体内部的场方程可导出用来研究恒星内部结构的微分方程 Tolman-Oppenheimer-Volkoff 方程，简称 T-O-V 方程(13a)。T-O-V 方程之所以比较符合实际，尚未造成谬误，是因恒星在其引力塌缩的过程中，可以较容易地向外排出热能，因而在解场方程时，可以忽略粒子的热抗力。但是，如果能知道恒星内部的质量和密度分布等边界条件，就无需解复杂的广义相对论方程，用简单的牛顿力学方程(13b)式即可。**

下面(13a)式，即 T-O-V 方程，来源于解爱因斯坦场方程，是在假定恒星内部是静态球对称的理想流体的状态下得出的。这里隐含着 2 个假设：1\*。M 只由定量的物质粒子组成。2\*，一部分热能可以自由流向外界，使恒星在核聚变前，物质引力收缩强于热压力对物质引力收缩的对抗。

下面(13a)式右端 3 个方括号因子是广义相对论对牛顿力学的修正。用它讨论恒星的内部结构时，恒星内部的压力  $P$  与密度  $\rho$ ，比熵  $s$ （每个核子平均的熵）等的分布与化学成分有关。如果不考虑(13a)式右端 3 个方括号因子的修正，使其均 = 1，则 T-O-V 方程还原为牛顿方程，即下面的(13b)式。但要解出(13a)式，需要作出许多简化假设条件，以便近似的求出  $P(R)$ ， $\rho(R)$ ， $M(R)$  的分布后，解出方程，这是很不容易的。

$$-R^2 dP/dR = GM(R)\rho(R)[1+P(R)/\rho(R)][1+4\pi R^3 P(R)/M(R)][1-2GM(R)/R]^{-1} \quad (13a)$$

按照牛顿力学，决定恒星基本特征的只有 2 种力，自身引力和压力在平衡时形成星体，如(13b)。

$$-dP/dR = GM(R)\rho(R)/R^2 \quad (13b)$$

因此，T-O-V 方程仍存在的最大未解决问题是：前面已经说过，在任何大于  $10^{15}$  克物体的中心，都必定存在一个由不同高密度物质粒子组成的坚实核心，以对抗其外层物质的引力塌缩。在实际上，因为在高温高压的恒星内部，除了引力之外，还有电磁力和弱作用力在起作用，往往形成有多于 2 层的结构，其  $M(R)$ 、 $\rho(R)$ 、 $P(R)$  往往是不能用一个统一的公式和模型来表述的。

考虑到物质粒子达到密度约  $10^{15-16}$  g/cm<sup>3</sup> 时，中子就紧靠在一起而产生极强的中子简并压力，足以对抗其引力收缩，而形成约  $3 M_0$  的黑洞，因而才能得出恒星级黑洞的奥本海默极限约为  $3 M_0$ 。

可见，如知道星体内部的质量密度等分布情况，就可直接用热力学方程解(13b)即可，无需解复杂的广义相对论方程而得到 T-O-V 方程，该方程只提出了一种物理概念，在实际上并无多大的用处。现在人们已经大致知道的真实情况是：小于  $(5 \sim 8) M_0$  的恒星，在其核聚变后，其残骸是在强烈爆炸的巨大内压力下，可塌缩成为白矮星、或中子星、或小的恒星级黑洞，还可能被爆炸成粉身碎骨的粒子散布到宇宙空间。问题是，为什么学者们不敢将史瓦西度规运用于恒星内部，而得出出现“奇点”的结论呢？如果有学者胆敢作如此假设，就会露馅，因为人们会问，为什么人们见不到“奇点”产生的大爆炸呢？因为宇宙中根本就不可能出现“奇点”。可见由史瓦西度规而得出黑洞内部出现时空颠倒和奇点等谬论，都是学者们根据自己的想象和需要，而刻意假定和曲解的结果，故不可能真实的存在于现实世界。

**【四】。进一步的分析和结论。**

《4-1》：场方程的最主要问题是其中的能量-动量张量项中的粒子没有热抗力。在解场方程时，弗里德曼和爱因斯坦和一直到现在科学家们**根本解释不了宇宙为什么会膨胀**。请大家理性的想一想，让一个只有粒子引力的场方程去解决宇宙膨胀的问题，不等于想要太监去传宗接代吗？**所以最后必然用不可知的万能药‘奇点’去解释**。再说，应用史瓦西度规的学者们并不知道大团能量-物质收缩成为黑洞的原因和过程，胡乱解释，错得离谱，才得出‘奇点’的谬论。最后，只因TOV方程只考虑纯粹物质粒子团的收缩，热能的排出相对于粒子团的质-能影响较小，才能得出概念基本正确的特殊解。

《4-2》：彭罗斯和霍金解场方程得出奇点的原因：

约四十多年前，在解广义相对论方程时，发现存在空-时失去意义的“奇点”。霍金写道：“罗杰·彭罗斯和我（霍金）在1965年和1970年之间的研究指出，根据广义相对论，**在黑洞中必然存在无限大密度和空间-时间曲率的‘奇点’**。这和时间开端时的大爆炸相当类似”<sup>[8]</sup>。**所以“奇点”成为爱因斯坦的广义相对论一个必不可少的组成部分**。<sup>[7]</sup>因为普通物质间的引力是一种纯粹的相互吸引，而在纯粹吸引作用下的物质分布是不可能达到静态平衡的。广义相对论认为星系演化经过黑洞最后还会塌缩成为“奇点”，宇宙开端有“奇点”。甚至可能存在“裸奇点”。爱因斯坦自己写了一篇论文，宣布恒星的体积不会收缩为零。所以罗杰·彭罗斯和霍金在爱因斯坦死后在错误假设条件下，对“奇点”的证明是违反爱因斯坦的初衷的。事实上，在真实的宇宙，没有发现“奇点”存在的蛛丝马迹。为了避免理论与实际矛盾的尴尬，彭罗斯于是不得不提出“宇宙监督原理”来加以避免。这和牛顿的“第一推动力”的错误思想如出一辙。“奇点”，这一理论病态的发现是理论研究的重要进展，却又与等效原理不协调。**问题恰恰在于：现实宇宙中没有纯引力作用。只有在密度极小的条件下，可忽略热抗力。**

《4-3》：宇宙中稳定的物质结构体是在不同的温度下构成不同的物质层次的。当物质结构从某一层级转变为另一层级时，会发生“相变”，两层级的结合处是“临界点”。适合于某一物质结构层次的数学方程达到其“临界点”后就会失效，正如理想气体状态方程不适用于其液体和固体状态一样，只能用于气体。当一大团物质粒子团形成一个小黑洞后，黑洞内外是2个极不相同的不连续的世界，不能用同一个方程式。这是史瓦西度规出错的根本原因。

《4-4》：(2a)是一个等式，从因果关系来看，应该是无限大的物质密度才能产生无限大时空曲率的“奇点”。但是，现在我们银河系，无数恒星级黑洞和星系中心的巨型黑洞已被观测所证实，而且我们的宇宙就是一个巨无霸黑洞。**在宇宙黑洞内，我们没有感受到“奇点”大爆炸的威胁，也没有感受被“奇点”吞噬的危险**。这说明彭罗斯和霍金根据爱因斯坦广义相对论方程得出的有关“奇点”的结论是一个违背真实物理世界的虚构怪物。

《4-5》。排除“奇点”的广义相对论有什么不好？现代科学家的头脑中都有一个怪物，就是终极理论 T.O.E。他们的病态不在于他们的数学公式，而在于他们的思维方式和认识论。他们是在把自己掌握的数学方程当作自己的上帝来信仰的。他们宁可迷信和服从自己的数学方程，也不相信不符合其数学方程的真实的物理世界。**科学家们常用不合逻辑和稀奇古怪的新观念去修补其数学方程中的缺陷，徒劳而犯错。**

《4-6》：宇宙中物质粒子的引力及其如影随形的温度斥力是一对永不分离的矛盾体，它们在各种不同条件下的平衡就构成宇宙中不同的稳定存在的物体和天体。同时用正确的逻辑上推断，如果能量-物质团中心无对抗自身引力塌缩的较坚实的核心，宇宙早在高密度的诞生初期就塌缩出无数的“奇点”了。哪会有现在庞大而复杂的宇宙？可见，**本身只有物质引力的广义相对论方程是有根本缺陷的**。在真实的物理世界，如果没有对抗引力收缩的各种排斥力，一块铁，一个人，一池水，以座山，地球等等都完全可以靠其自身的引力收缩成为“奇点”，这是多么荒谬而违反现实和热力学定律的结论。

《4-7》广义相对论方程与其观点的矛盾使场方程只能考虑物质粒子之间的引力作用，无法考虑宇宙中大部分辐射能的排斥作用、引力能和辐射能之间的互相转换，这是几乎使所有场方程的特殊解都出现重大错误的原因。

前面说过广义相对论方程还有一个最大的矛盾就是：在宇宙中，物质粒子与辐射能的关系既是相反相成和如影随形的，一方面相对论承认质量-能量互换和守恒定律的。但是另一方面由于物质粒子的质量与辐射能的相当质量差别巨大，在物质粒子中，热能相对的小，所以主要显现为引力而导致粒子团的收缩。而辐射能的引力质量相对的小，所以主要显现为有排斥力的热能而导致辐射能的降温膨胀。**相对论为了维护其时空弯曲的观点，既否定辐射能有相当的引力质量作用；又**

不承认辐射能的排斥降温的膨胀作用。在宇宙中,辐射能占能量-物质总数的 74%,而物质粒子只占 26%。所以宇宙即使不是黑洞,也会膨胀。场方程中的能量-动量张量项中只有引力,没有辐射能的斥力,无法解决宇宙膨胀的问题,只能用‘奇点’的大爆炸、或将宇宙当做稳恒态的孤立系统来处理,这就是爱因斯坦、弗里德曼、R-W 度规等的特殊解,必然导致不切实际而谬误流传的原因。

另一方面,物质粒子团的收缩过程就是粒子之间的引力能转变为辐射能(热能)的过程,所以随着粒子间的距离缩小、密度增加,必然随着增加热能和温度,以对抗粒子的引力收缩。只有粒子团内部排出热能、降低温度后,粒子团才有可能继续收缩一些;一旦排热降温被阻止,温度得到保持,收缩就会停止。这就是符合热力学规律的实际情况。彭罗斯和霍金证明<“奇点”成为爱因斯坦的广义相对论一个必不可少的组成部分>,完全是否定‘引力能与辐射能可以互换’和‘辐射能有排斥作用’的结果。场方程几个少数的特殊解,如 TOV 方程、水星绕日运动、光线在恒星附近偏折等之所以比较符合实际,是因为可以在将星体视为粒子团单纯的引力作用时,可以完全忽略辐射能及其排斥作用。

**《4-8》。黑洞理论之所以能有效而符合实际地解决宇宙学和黑洞的问题,**是因黑洞的总能量-物质  $M_b$  是其等价的能量(辐射能)和物质的总和,与二者的如何转化和比例无关。黑洞的膨胀或收缩  $\Delta R_b$  只取决于  $M_b$  总量的增减。按照公式(1c),  $\Delta M_b = \Delta R_b(C^2/2G)$ , 黑洞的膨胀  $\Delta R_b$  只与其吞噬外界能量-物质的总量  $\Delta M_b$  成正比,其收缩  $\Delta R_b$  与发射霍金辐射带走的  $\Delta M_b$  成正比。**在真实的物理世界,宇宙中的温度不可能达到无限高和绝对零度,只有黑洞内部强大的引力可使辐射能不泄露,而在收缩时提高热能密度和温度,**从而使热能的抗力完全能够对抗引力的继续收缩。并且当黑洞只能因不停地发送霍金辐射而最后收缩成为普朗克粒子  $m_p$ 、即达到时空不连续的普朗克领域(Planck Era)时,而解体消失在普朗克领域,这也是“临界点”。此时广义相对论和黑洞理论就都在普朗克领域失去了作用。因此,黑洞不可能再继续收缩和增高密度,达到虚幻的、无限大密度的“奇点”。<sup>[1]</sup>

#### 《4-9》。广义相对论方程与黑洞理论的比较

广义相对论方程	黑洞理论
1; 封闭、孤立系统	1; 开放系统
2; 等压模型	2; 等压或不等压均可
3; 密度均匀	3; 密度不必均匀
4; 忽略辐射能的热抗力	4; 必须有辐射能热抗力

5; 无法质-能互换	5; 必须质-能互换
6; 只适用于物质粒子团	6; 物质粒子与辐射能通用
7; 方程中无法用辐射能	7; 公式中质-能通用互换
8; 纯引力不能解宇宙膨胀	8; 黑洞因吞噬质-能膨胀
9; 否认大物体有高密度核	9; 密度不均,必有核心
10; 解方程须知质量密度分布	10; 无需知黑洞内部状况
11; $\Omega$ 无法判别宇宙是封闭或开放,膨胀或收缩	11; 吞噬外界质-能膨胀,封闭或开放,膨胀或收缩
12; 纯引力收缩必现奇点	12; 最终收缩成为普朗克粒子而消亡
13; 黑洞内时空颠倒、内	13; 人类就是在宇宙黑洞部真空、中心是奇点内,没有感觉异常

====全文完====

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**Queries about The Equation of General Theory of Relativity---- 《Part Two》**  
**====Why Could Many Wrong Results Be Got From Solving The Equation of The General Theory of Relativity ?====**

Zhang Dongsheng 张洞生  
[zhangds12@hotmail.com](mailto:zhangds12@hotmail.com); zds@outlook.com

**【Abstract】**。 In this article, author analyzed and pointed out why many big wrong results (such as Singularity, Freidmann equation, Schwarzschild metric, etc, ) could be got by some famous scientists in the past from solving the Equation of the General Theory of Relativity (EGTR) with many simplified hypothetical conditions. No such extra conditions, nobody could find out some special solutions from EGTR. For contrasting EGTR with the black-hole theory, author demonstrated that, only the black-hole theory completed by author lately could correctly solve the most important problems in black holes and cosmology, because no simplified hypothetical conditions needed in the black-hole theory.

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**【Key Words】**。 Equation of the General Theory of Relativity (EGTR); Singularity; Freidmann equation; R--W metric; Schwarzschild metric; black-hole theory; Planck particle;

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## Antifungal potentials of indigenous black soap commonly used in Ibadan, Nigeria

<sup>a</sup>Jonathan SG<sup>1</sup>, Efunshile AM<sup>2</sup>,<sup>b</sup>Olawuyi OJ<sup>1</sup>,<sup>a</sup>Babalola BJ<sup>1</sup>, Efuntoye MO<sup>3</sup> and <sup>a</sup>Dixon DO<sup>1</sup>

<sup>a</sup>Mycology&Biotechnology Unit, <sup>b</sup>Genetics & Molecular Biology Unit, <sup>1</sup>Department of Botany & Microbiology, University of Ibadan, Ibadan, Nigeria. <sup>2</sup>Department of Medical Microbiology, Ebonyi State University, Abakaliki, Nigeria <sup>3</sup>Department of Microbiology, Olabisi Onabanjo University, Ago Iwoye, Nigeria  
[gbolagadejonathan@gmail.com](mailto:gbolagadejonathan@gmail.com)

**Abstract:** Antifungal potentials of indigenous black soap from Ibadan, South western Nigeria were investigated. Seven fungal species (*Trichophyton rubrum*, *T. mentagrophytes*, *T. proliferans*, *Microsporium canis*, *Trichophyton* .sp., *Aspergillus* sp. and *Candida albicans*) which are responsible for different kind of infections were tested against black soap samples collected from different locations within Ibadan city. All the test mycoorganisms were found to be susceptible to the black soap samples with varying degree of zones of inhibition (ZOI). *Candida albicans* was the most susceptible fungus in all tested samples. It produced 25mm ZOI at 100% concentration closely followed by the same sample at 75% (23mm). *Trichophyton mentagrophytes* was the highly susceptible to sample B at 100% concentration having 22mm ZOI. *Trichophyton proliferans* was susceptible to sample B. *M.canis* was sensitive to sample E at 100% concentration closely followed by sample C and D at the same concentration. At 75% concentration, sample D also produced moderate inhibitory effect on *M.canis* (15mm). Generally, *C. albicans* was the most susceptible fungi to all the indigenous black soap samples used in these studies while *Aspergillus* sp. was least susceptible. However, *Aspergillus* sp was susceptible to sample D and E at 100% concentration (15mm) [Jonathan SG, Efunshile AM, Olawuyi OJ, Babalola BJ, Efuntoye MO and Dixon DO **Antifungal potentials of indigenous black soap commonly used in Ibadan south-western Nigeria.** *Academia Arena* 2013;5(7):50-55] (ISSN 1553-992X). <http://www.sciencepub.net/academia>. 7

**Keywords:** Indigenous black soap, inhibition, Nigeria, pathogenic fungi, susceptibility,

### 1.INTRODUCTION

Indigenous black soap has been used by West African natives from the time immemorial. This dark brown, soft and cleansing substance is known as 'sabulun salo' in Hausa, 'anago', 'alata samina' in Ghana and 'eko zhiko' in Nupe (Getradeghana, 2000; David, 2005; Aliyu *et al.* 2012). It is also referred to as *òsèdúdú* or 'abuwe' among the Yoruba speaking people of south western Nigeria (Bella, 2011).

.In south west Nigeria, indigenous black soap may be made from either roasted plantain skins or dried waste cocoa and vegetable oil or palm oil pods and oil palm or palm nut oil. (Ikpoh *et al.*, 2012). In the northern part of Nigeria, it is produced from a mixture of vegetable oil palm kernel oil and shea butter (Getradeghana, 2000; Aliyu *et al.* 2012.) Black soap is preferred for bathing due to its natural source of vitamins A and E (Getradeghana, 2000). Because of its phenolic contents, it is generally used to cure skin rashes among the traditionalists (Mike, 2008; Ekwenye and Ijeomah 2005). African black soap is centuries old, has numerous benefits is naturally scented with attractive odour. It is used to improve the skin quality.

Bathing is one of the most important ways of practicing proper hygiene and this is done with the aid of soap. Hygienic conditions are therefore necessary for maintaining good health in homes, communities, business centers and in health care settings (Kampf and

Kramer 2004). Using quality soaps with antiseptic properties helps to reduce the effect of disease causing micro-organisms on the skin. For years, black soap has also been used to achieve beautiful and healthy skin. African women have also used this natural soap for bathing and washing their hair (Ikpo *et al.*, 2012). There is a general belief among the Yoruba people that black soap will always enhance soft and disease free skin.

Indigenous African black soap is scented with distinct aroma which could be employed by local people to remove body odour. Black soap is a multi-purpose cleanser which can be used by children as well as adults. Charcoal or ash from dried cocoa pods in the soap may help to inhibit bacteria and microorganisms, providing more thorough cleansing and skin protective values (Ugbogu, 2006). Black soap can help reduce acne outbreaks by reducing oiliness and killing bacteria which cause acne. Some proponents say using black soap reduces the appearance of acne scars. used in black soap have been used as a traditional folk treatment for skin irritation (Getradeghana, 2000). Some black soap formulas contain honey, also known for its healing properties. Black soap can be used by people with sensitive skin, normal, dry or oily skin. It can help with dandruff when used as a shampoo and has antiseptic and anti-fungal properties while

moisturizing and protecting the skin (Getradeghana, 2000).

One of the constituent of the African black soap is ash and this provides gentle exfoliation. This gentle exfoliation may help reduce the appearance of fine lines and discolorations and reduce razor bumps (Getradeghana, 2000). Black soap is milder and gentle on the skin. It is richly endowed with glycerin which is a good moisturizer, most of the synthetic antiseptic soaps possess detergents, isopropylalcohol, BHT and some other chemicals which causes skin irritation on dry and sensitive skin types. (Omobuwajo *et al.* 2007). This irritant strips the skin of its natural hydrating oils hence making the skin feel tight, itchy and flaky. Individuals that make use of these synthetic antimicrobial soaps run the risk of infertility due hormonal imbalance instilled by some of the chemicals present in these soaps Omobuwajo *et al.* 2007). Also the use of the locally produced black soap is cost effective, readily obtained and easy to use.

Microorganisms found on the human skin are of two distinct populations: resident and transient (Steven *et al.*, 2003; Jawetz *et al.*, 2010). Resident microorganisms such as *Candida albicans*, *Malassezia* sp. are considered as floral inhabitant of the skin. (Garner and Favero, 1985). Transient microorganisms are found on and within the epidermal layer of the skin, as well as other areas of the body where they do not normally reside. Almost all disease producing microorganisms belong to this category. (Oluranti *et al.*, 2012). Pathogen that may be present on the skin as transient types includes *Esherichia coli*, Dermatophytes such as *Microsporium*, *Trichophyton*, *Salmonella* sp., hepatitis A virus

Fungal infections of the skin are also known as 'mycoses'. They are common and generally mild. However, in immuno suppressed individual, fungi can sometimes cause serious disease (Jonathan *et al.*, 2012a). A variety of environmental and physiological conditions have also been reported to contribute to the development of fungal diseases (Jonathan *et al.*, 2011). However, the main objective of this research study was to carry out in-vitro investigations in verifying the claim of some Yoruba traditionalists in using black soap for curing skin infections caused by fungi

## 2. Materials and methods

### 2.1 Collection of samples

Black soap samples were collected from retailers in five different markets (Ojoo, Agbowo, Alesinloye, Bodija and Sango) within Ibadan city and wrapped in sterile aluminium foil and were brought to the laboratory for investigation.

### 2.2. Test mycoorganisms

The pathogenic fungi used in this study were *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Trichophyton proliferans*, *Trichophyton* sp., *microsporium canis*, and *Candida albicans* which were collected from the Mycology unit of Medical Microbiology Department Lagos University Teaching Hospital (LUTH) Idi-Araba Lagos state and *Aspergillus* sp. was obtained from the Mycology Laboratory, Department of Botany and Microbiology, University of Ibadan.

### 2.3 Sterilization and aseptic conditions

The glass wares such as Petri-dishes, pipettes, Erlenmeyer's flasks, beakers were sterilized in a dry air oven at 160 °C for 3 hr. Other materials such as cork borer were sterilized by flaming using spirit lamp. The work benches were surface sterilized by wiping with 70% ethanol. A spirit lamp was also used during all bench work periods.

### 2.4 Media preparation and Culture techniques

The media used for this study was saboroud dextrose agar (SDA) for the dermatophyte species, Potato Dextrose Agar (PDA) for *Aspergillus* sp. and yeast extract agar (YEA) for *Candida albicans*. These were prepared according to manufacturer's prescriptions. They were all transferred from slants bottles and sub-cultured unto appropriate fresh media plates. The plates were incubated at 30 °C for a period of five days.

### 2.5 Inoculum preparation

The surface of the Petri-plates containing the filamentous fungus and the dermatophytes were flooded with ten (10) ml of sterile distilled water. 0.5 ml containing approximately  $2.4 \times 10^6$  cells/ml were then used as the inoculum.

For the *Candida albicans*, loop full of each fungus was transferred into sterile 20 ml of yeast extract medium in a 50 ml Erlenmeyer's flask. Incubation was at 35 °C for 48 hours. A loop full was then streak onto the YEA.

### 2.6 Antifungal activity of black soap

The agar well diffusion technique was used in the investigation of the antifungal potentials of the various black soaps against the test organisms. 0.5 ml of the inoculum was transferred aseptically using a sterile pipette into the Petri-plates and the suitable molten agar for each fungus was poured into the plates and swirled gently for even distribution. This was then allowed to solidify. Six holes were made into the already solidified agar medium using a sterile cork borer of 5 mm diameter. Each well was then filled with the black soap dilution and allowed to stand for

30 minutes on the bench to allow for proper diffusion of the soap suspension into the medium. Plates were then incubated at 30 °C for 72 hours (For the filamentous fungi) and at 35 °C for 24-48 hours (for the yeast). The relative antifungal activity of the black soap was taken as the susceptibility of the test organisms to the black soap as indicated by the clear zone of growth of inhibition around the wells. The zone of inhibition was recorded in millimetres (mm).

## 2.7 Data Analysis

Data collected was analyzed using ANOVA. Means were separated using Duncan Multiple Range Test (Duncan, 1955).

## 3. Results and Discussion

**3.1 Antifungal potential of black soap samples at various concentration:** From this study, the black soap samples were able to inhibit the growth of the test fungi used in this study. The mycelia growth of the test fungi except (*Trichophyton sp.*) were significantly ( $p < 0.05$ ) inhibited as indicated by clear zones of inhibition. At 100% concentration, the soap samples obtained from Sango (sample A) showed no significant ( $p < 0.05$ ) mycelia growth inhibition of *Trichophyton sp.* (0.00mm) while *T. rubrum*, *T.*

*mentagrophytes*, *T. proliferans* and *M. canis* were partially inhibited. Sample A was however observed to have the most significant effects on *Candida albicans* (6.00mm) and *Aspergillus sp.* (4.0). Sample B however exerted higher significant ( $p < 0.05$ ) effect on all the pathogenic fungi than the sample A with *T. mentagrophytes* (28.0mm) as the most significant ( $p < 0.05$ ) black soap ;while *Trichophyton sp.* (9.0mm) was least inhibited. There were no significant ( $p < 0.05$ ) difference in the treatments of the pathogenic fungi by the black soap sample C and E, although both recorded a more significant ( $p < 0.05$ ) control when compared to sample A. However, sample D exhibited the highest inhibitory effect on *Candida albicans* (25.0mm) and least effect on *T. prolierans* (14.5mm). Generally, at 100% soap concentration, sample B appeared to be the most significant soap ( $p < 0.05$ ) in against *T. mentagrophytes*. However, sample D was best effective against *Trichophyton sp.* and *Candida albicans*, while *T. rubrum*, *T. proliferans* and *M. canis* were significantly ( $p < 0.05$ ) inhibited by sample E. Both sample D and E had higher significant ( $p < 0.05$ ) activities against *Aspergillus sp.* than other soap samples

**Table 3.1: Antifungal potential of different black soap samples obtained from different markets at 100% concentration (1 gram of soap in 100mls of pure distilled water)**

Organisms	Soap Samples and location/Zone of Inhibition (mm)				
	A (Sango)	B(Aleshinloye)	C(Agbowo)	D(Ojoo)	E(Bodija)
<i>Trichophyton sp.</i>	0.00 <sup>c</sup>	9.0 <sup>c</sup>	13.5 <sup>a</sup>	18.0 <sup>ab</sup>	14.0 <sup>a</sup>
<i>T. rubrum</i>	0.10 <sup>c</sup>	15.0 <sup>bc</sup>	18.5 <sup>a</sup>	16.5 <sup>ab</sup>	20.0 <sup>a</sup>
<i>T. mentagrophytes</i>	0.20 <sup>c</sup>	28.0 <sup>a</sup>	17.5 <sup>a</sup>	22.0 <sup>ab</sup>	16.0 <sup>a</sup>
<i>T. proliferans</i>	0.28 <sup>c</sup>	17.0 <sup>b</sup>	11.5 <sup>a</sup>	14.5 <sup>b</sup>	20.0 <sup>a</sup>
<i>Microsporium canis</i>	1.5 <sup>c</sup>	12.0 <sup>bc</sup>	16.0 <sup>a</sup>	15.0 <sup>b</sup>	17.5 <sup>a</sup>
<i>Candida albicans</i>	6.00 <sup>a</sup>	16.0 <sup>bc</sup>	17.0 <sup>a</sup>	25.0 <sup>a</sup>	20.5 <sup>a</sup>
<i>Aspergillus sp.</i>	4.0 <sup>b</sup>	10.0 <sup>bc</sup>	13.0 <sup>a</sup>	15.0 <sup>b</sup>	15.0 <sup>a</sup>
SEM	1.09	3.87	3.64	5.08	7.11

Data are means of three replicates. Values followed by the same letters are not significantly different by Duncan's multiple range test ( $P \leq 0.01$ ).

In-vitro antifungal tests performed using 75% concentration of the soap samples showed less significant ( $p < 0.05$ ) inhibitory effect when compared to the activities of the black soap at 100% concentration. This is evident in sample A where the mycelia reductions of *Trichophyton sp.* (0.00), *T. rubrum* (0.08), *T. mentagrophytes* (0.10), *T. proliferans* (0.18), *M. canis* (0.92) and *Aspergillus sp.* (1.0mm) showed no significant ( $p < 0.05$ ) difference in the soap treatment. Both sample B and C treatment showed ( $p < 0.05$ ) significant control of *Trichophyton sp.*, *T. rubrum*, *M. canis* and *C. albicans* while sample D exerted the highest significant ( $p < 0.05$ ) inhibition on *C. albicans*

(23.0mm), whereas, no significant ( $p < 0.05$ ) difference was observed among the pathogenic fungi treated by sample E (Table 3.2).

The results of the antifungal potentials of black soap obtained from different sources conducted at 50% concentration against pathogenic fungi showed the reducing inhibitory effects. The soap samples demonstrated varying level of inhibitory effects on the fungi tested. Sample B showed the most significant ( $p < 0.05$ ) inhibition of *T. mentagrophytes* (12.0mm). Sample C inhibited *T. rubrum* (10.5mm) moderately while sample D had some notable effect on *Trichophyton sp.* (10.2mm) and *Candida albicans*



(17.0mm). Sample E was however found to be most effective in the inhibition of *T. proliferatum*,

*Microsporium canis* and *Aspergillus sp.* (Table 3.3)

**Table 3.2: Antifungal potential of different black soap samples obtained from different markets at 75% concentration (75mls of the above concentration in 25mls pure distilled water)**

Organisms	Soap Samples and location/Zone of Inhibition (mm)				
	A (Sango)	B(Aleshinloye)	C(Agbowo)	D(Ojoo)	E(Bodija)
<i>Trichophyton sp.</i>	0.00 <sup>b</sup>	6.0 <sup>bc</sup>	7.5 <sup>bc</sup>	16.0 <sup>bc</sup>	10.0 <sup>a</sup>
<i>T. rubrum</i>	0.08 <sup>b</sup>	10.0 <sup>bc</sup>	14.5 <sup>a</sup>	13.5 <sup>bcd</sup>	15.0 <sup>a</sup>
<i>T. mentagrophytes</i>	0.10 <sup>b</sup>	22.0 <sup>a</sup>	10.2 <sup>bc</sup>	18.0 <sup>b</sup>	14.0 <sup>a</sup>
<i>T. proliferans</i>	0.18 <sup>b</sup>	13.0 <sup>bc</sup>	8.5 <sup>bc</sup>	11.5 <sup>cd</sup>	17.0 <sup>a</sup>
<i>Microsporium canis</i>	0.92 <sup>b</sup>	7.0 <sup>bc</sup>	11.0 <sup>b</sup>	12.0 <sup>cd</sup>	15.5 <sup>a</sup>
<i>Candida albicans</i>	4.00 <sup>a</sup>	14.0 <sup>b</sup>	15.0 <sup>a</sup>	23.0 <sup>a</sup>	16.5 <sup>a</sup>
<i>Aspergillus sp.</i>	1.0 <sup>b</sup>	5.0 <sup>c</sup>	7.0 <sup>d</sup>	10.0 <sup>c</sup>	13.0 <sup>a</sup>
<i>SEM</i>	0.83	4.53	1.99	2.69	4.15

Data are means of three replicates. Values followed by the same letters are not significantly different by Duncan's multiple range test ( $P \leq 0.01$ ).

**Table 3.3: Antifungal potential of different black soap samples obtained from different markets at 50% concentration (50mls of the above concentration in 50mls pure distilled water)**

Organisms	Soap Samples and location/Zone of Inhibition (mm)				
	A (Sango)	B(Aleshinloye)	C(Agbowo)	D(Ojoo)	E(Bodija)
<i>Trichophyton sp.</i>	0.00 <sup>d</sup>	1.0 <sup>e</sup>	5.5 <sup>d</sup>	10.2 <sup>b</sup>	4.4 <sup>c</sup>
<i>T. rubrum</i>	0.03 <sup>cd</sup>	6.0 <sup>c</sup>	10.5 <sup>a</sup>	9.3 <sup>b</sup>	9.0 <sup>b</sup>
<i>T. mentagrophytes</i>	0.06 <sup>cd</sup>	12.0 <sup>a</sup>	8.2 <sup>b</sup>	10.0 <sup>b</sup>	10.0 <sup>ab</sup>
<i>T. proliferans</i>	0.10 <sup>c</sup>	10.0 <sup>b</sup>	3.0 <sup>e</sup>	5.8 <sup>c</sup>	12.0 <sup>a</sup>
<i>Microsporium canis</i>	0.62 <sup>b</sup>	4.0 <sup>d</sup>	6.5 <sup>c</sup>	5.0 <sup>c</sup>	10.5 <sup>ab</sup>
<i>Candida albicans</i>	1.00 <sup>a</sup>	9.0 <sup>b</sup>	10.5 <sup>a</sup>	17.0 <sup>a</sup>	8.5 <sup>b</sup>
<i>Aspergillus sp.</i>	0.00 <sup>d</sup>	1.0 <sup>e</sup>	3.5 <sup>e</sup>	5.4 <sup>c</sup>	6.0 <sup>c</sup>
<i>SEM</i>	0.04	1.07	0.57	1.98	1.17

Data are means of three replicates. Values followed by the same letters are not significantly different by Duncan's multiple range test ( $P \leq 0.01$ ).

African black soaps has been reported to be rich in naturally occurring vitamin A, E and iron and has been found effective as cleansers, anti-aging, and also in skin and hair treatments (Kelly, 2011). The African black soap is thus a welcomed body treatment especially in the developing countries

In is study, the antifungal properties claim of black soap were found to be genuine as the samples collected Ibadan were found to generally inhibited the growth of all the test fungi. This result was in agreement with the earlier observation of Ajose (2007) who reported the antiseptic properties of black soap against the fungal skin infections. The potentials of some commercially available black soap tested in-vitro reveals their efficacy against some common dermatophytes; *T. rubrum*, *T. mentagrophytes*, *T. proliferans*, *M. canis*, *C. albicans* and *Aspergillus sp.* at different concentration levels. This finding also agree with the report of Kilani *et al.* (2007) that antifungal activity of herbal decoction was effective

where herbal medicine are still relied on to meet their health needs, the use of which has also been encouraged and guided by the World Health Organization has been reported by Ukueze and Abariku (1998).

against *Candida albicans*, *Trichophyton rubrum* and *Microsporium sp.*All the test organisms were susceptible to black soap samples used in this study. The control effect of this African soap could be attributed to the presence of some antimicrobial phytochemicals such as; alkaloids, tannins, flavonoids, cyanogenic glycoside and saponins, which may in turn account for the antifungal efficacy(Oluranti *et al.*,2012;Jonathan *et al.*,2012b). This results as obtained in this investigation was also in agreement with the report of Omobuwajo *et al.* (2007) on the efficacy of *Cassia senna* formulated black soap against some pathogenic microorganisms on human skin.The observation

obtained in this studies affirmed the report of Oladele *et al.*, (2010) who incorporated into the black soaps the powdered leaves of *Senna alata* and *Ageratum conyzoides* which are known for the treatment of skin had significant control diseases. These workers had significant control of pathogenic fungi responsible for skin diseases .

#### 4.0. Conclusion

The pathogenic fungi used in this study were significantly susceptible against various concentrations of the soap decoction while the varying degree in the anti-fungal potentials of the samples of the black soap obtained from various locations could be attributed to the variations in the preparation of the black soaps, since various samples were prepared differently using various materials. This study revealed that that black soap possessed in-vitro antifungal properties.

#### Correspondence to:

Dr Segun Gbolagade Jonathan  
Department of Botany & Microbiology,  
University of Ibadan, Ibadan, Nigeria.  
**Email:** [gbolagadejonathan@gmail.com](mailto:gbolagadejonathan@gmail.com)

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## The role of personality traits for academic achievement (Case Study: 412 Iranian Students)

Mousavi Ebrahim Abadi, Hossein \*

University of Welfare and Rehabilitation Sciences

[mousavi\\_e\\_a@yahoo.com](mailto:mousavi_e_a@yahoo.com)

**Abstract:** The personal determinants of academic achievement and success have captured the attention of many scholars for the last decades. Among other factors, personality traits and self-efficacy beliefs have proved to be important predictors of academic achievement. The present study examines the unique contribution and the pathways through which traits and academic self-efficacy beliefs are conducive to academic achievement at the end of junior and senior high school. Participants were 412 Iranian students, 196 boys and 216 girls, ranging in age from 13 to 19 years. The hypothesized relations among the variables were tested within the framework of structural equation model. As a preliminary step, we computed the correlations between each of the Big Five at times 1 and 3, junior high-school grades at time 2, and high-school grades at time 4. The correlations were partialled for the other personality dimension in order to disentangle the unique effects of each the Big Five. Preliminary analyses showed that openness and conscientiousness were the only personality traits associated with school performance. The unique contribution of extraversion, agreeableness, and emotional stability at times 1 and 3 were not significant.

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**Key words:** personality, self-efficacy, academic achievement, traits

### 1. Introduction

The personal determinants of academic achievement and success have captured the attention of many scholars for the last decades (Robbins et al., 2004). In particular, to identify the best predictors of scholastic performance has been a major concern of both researchers and educators aimed to value the potentials of talented students and to develop proper interventions for students at risk of academic failure. Among other factors, both personality traits and self-efficacy beliefs have proved to be important predictors of academic achievement (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Britner & Pajares, 2006; Caprara, Barbaranelli, Pastorelli, & Cervone, 2004; Caprara et al., 2008; Chamorro-Premuzic & Furnham, 2003; Conard, 2006; Furnham, Chamorro-Premuzic, & McDougall, 2003; Gore, 2006; Komaraju & Karau, 2005; Marsh, Trautwein, Ludtke, Koller, & Baumert, 2006; Martin, Montgomery, & Saphian, 2006; Pajares, 2002; Pajares & Schunk, 2001; Robbins et al., 2004). Yet, most studies have addressed the contribution of personality traits and self-efficacy beliefs to academic achievement separately, as independent one from another. Exaggerations of diversities among theories and traditions in which traits and self-efficacy beliefs were rooted may lead to miss important opportunities of integration. In conceiving personality as a complex system (Caprara & Cervone, 2000), one may view at traits and at self-efficacy beliefs as both crucial to account for academic achievement, as for many other performances, although they address different structures

and processes and operate at different levels and at different distance from academic performance. Whereas traits are relatively unconditional behavioural tendencies that attest to individual's potentials in broads domain of functioning (McCrae & Costa, 1999), self-efficacy beliefs are knowledge structures that attest to the unique properties of human beings to self-reflect and learn from experience (Bandura, 1997). In this regard, prior studies have pointed to the joint contribution of basic predispositions and self-efficacy beliefs in predicting job performance (Chen, Casper, & Cortina, 2001; Kanfer, 1992; Martocchio & Judge, 1997), political participation (Caprara, Vecchione, & Schwartz, 2009), pro-social behaviour (Caprara, Alessandri, Di Giunta, Panerai, & Eisenberg, 2010), and career interest (Nauta, 2004). Ultimately, one may argue that self-efficacy beliefs may mediate, at least in part, the influence of basic traits on specific abilities and performances, by sustaining the cognitive, affective and motivational processes leading to successful performance. We consider basic traits (i.e., conscientiousness and openness) and academic self-efficacy beliefs, as layers of a hypothetic architecture of personality, in which: (i) basic traits are relatively unconditional, broad dispositions referring to what a person 'has' (level 1); (ii) and academic self-efficacy is a knowledge structure (i.e., a set self-related beliefs) operating at an intermediate level between broad dispositions and specific behaviour (Caprara et al., 2010). This reasoning echoes previous distinctions made by both McAdams' (1995) and Graziano, Jensen-Campbell, and Finch (1997) in regard

to levels of analysis, while assigning to self-efficacy a mediating role in linking basic dispositions to specific behaviours. Although our layers do not fully overlap with McAdams' (1995) levels of analysis, we share the view that individual differences in personality should be addressed at different levels, as well as the belief that a comprehensive view of personality should account for both traits and self-processes. Previous studies in education have pointed to the opportunity to address different personality constructs like traits and motivational and volitional processes (e.g., goal orientation) that can mediate the influence of traits on school performance and achievement (De Raad & Schouwenburg, 1996; Payne, Youngcourt, & Beaubien, 2007). Nonetheless, at our knowledge, any study other than the one of Caprara et al. (2004) has addressed both traits and self-efficacy beliefs in the academic domain. Peterson and Whiteman (2007) have found positive correlations between openness and academic self-efficacy in a sample of university students; however, they have explored only the associations with self-concept related to academic domain, and not with academic achievement.

According to our reasoning, in conceiving this study we argued that certain traits are crucial in fostering learning. Clearly, different traits may influence behaviour at different levels. Whereas it seems reasonable that conscientiousness would sustain self-regulative processes leading to school achievement, openness may impact more generally in fostering pupil's attitudes towards school-related matters and in enlarging epistemic motivation and cultural interests. However, both traits reflect basic differences in personality that hardly can be modelled by experience. Self-efficacy, instead, impact generally on school achievement by setting the basis for pupil's academic aspirations and by linking basic disposition to effective achievement. Yet, empirical findings capable of elucidating how traits and self-efficacy beliefs operate are needed to understand and promoting students' academic performance and success. To this aim, a longitudinal research design has been used to examine the pathways through which traits and academic self-efficacy beliefs contribute to academic performance.

## 2. Main body

Personality traits and academic performance Many personality researchers have argued that personality traits account for a significant portion of variance in academic performance (Chamorro-Premuzic & Furnham, 2003; Duff, Boyle, Dunleavy, & Ferguson, 2004; Furnham et al., 2003; Komarraju & Karau, 2005; Marsh et al., 2006; Martin et al., 2006). Martin et al. (2006) found that individual differences in personality played a unique role in undergraduate performance

across 4 years of coursework over and above the effects due to high-school performance and cognitive ability (i.e., achievement test scores). Chamorro-Premuzic and Furnham (2003), using two longitudinal samples of British university students, examined the relationship between personality factors and academic performance. Personality scores assessed during the first few weeks of the academic year resulted significantly associated to final exam and course work assessed 3 years later. In addition, when the predictive power of personality traits was related to both academic behaviours such as attendance and class participation and teacher's predictions, personality traits were found to account for an additional 10–17% of unique variance in academic performance. In a further study of Furnham et al. (2003), personality traits accounted for about one-fifth of the variance in exam marks and as much as one-third of the variance in essay grades for a 2-year period. Conscientiousness has been considered as the basic trait of the Big Five Model most closely linked to will to achieve (Digman, 1989). Recent meta-analysis pointed to conscientiousness as the strongest predictor of academic performance at both the secondary and tertiary levels of education, even after controlling for intelligence (Poropat, 2009). It was associated with sustained effort and goal setting (Barrick, Mount, & Strauss, 1993), both of which contribute to academic success (Steel, 2007), to compliance and concentration on homework (Trautwein, Ludtke, Schnyder, & Niggli, 2006), to time management and effort regulation in learning (Bidjerano & Dai, 2007). This is in accordance with previous findings attesting to the association of conscientiousness with course performance, class attendance, and final grades (Conard, 2006). Moreover, each specific facet of conscientiousness (e.g., diligence, dependability, self-discipline, prudence, competence, dutifulness, order, and achievement striving) was conducive to performance in academic settings, attainment of academic honors, and lower disciplinary infractions (MacCann, Duckworth, & Roberts, 2009), and independently predicted Grade.

Point Average (GPA) (Chamorro-Premuzic & Furnham, 2003; Furnham et al., 2003; Martin et al., 2006), academic motivation (Komarraju & Karau, 2005), effective learning styles (Duff et al., 2004), and academic aspirations (Rottinghaus, Lindley, Green, & Borgen, 2002). Other findings have pointed to openness as a major correlate of academic achievement and success (Asendorph & Van Aken, 2003; Blickle, 1996; De Raad & Schouwenburg, 1996; Paunonen & Ashton, 2001), effective learning style (Duff et al., 2004), and higher academic aspirations (Rottinghaus et al., 2002). Furthermore, openness has been positively associated to final school grades and to strategies that emphasize critical thinking (Bidjerano & Dai, 2007; Komarraju & Karau, 2005), approach to learning (Vermetten,

Lodewijks, & Vermunt, 2001) and learning motivation (Tempelaar, Gijsselaers, Schim Van Der Loeff, & Nijhuis, 2007). Chamorro-Premuzic and Furnham (2003) found openness positively related to intelligence and intellectual curiosity. Likewise, Graziano et al. (1997) assessed the Big Five from self-reports of 5th to 8th graders and found openness positively associated with both self-report and teacher ratings of academic adjustment. Other studies have further underlined the predictive value of both conscientiousness and openness. Mervielde (1994) and Mervielde, Buyst, and De Fruyt (1995) analysed teacher ratings on different age groups (from 4 to 12 years) and found that both traits showed high correlations with academic achievement. Similar results were found by John, Caspi, Robins, Moffitt, and Stouthamer-Loeber (1994) who developed scales for the Big Five from Q-sorts of 12- to 13-year-old boys rated by their mothers. In particular, teacher reports of school performance correlated with conscientiousness and openness while verbal, performance, and full scale IQ correlated with openness. Conscientiousness and openness were the most important personality correlates of academic achievement across different informants (self, teacher, and parent) also in a study conducted by Barbaranelli, Caprara, Rabasca, and Pastorelli (2003).

Other major traits like extraversion, neuroticism, and agreeableness have shown less consistent associations with academic achievement than conscientiousness and openness. Few studies have reported a negative association between neuroticism and academic performance, but most studies have reported non-significant results (Martin et al., 2006). In reality, neuroticism fails to predict scholastic achievement over and above cognitive ability (Ridgell & Lounsbury, 2004). Extraversion has shown controversial association (i.e., positive, negative, and non-significant) with academic performance. In reality, different facets of extraversion may relate to academic success in different ways (Martin et al., 2006). Whereas agreeableness was associated with classroom behaviour (Graziano et al., 1997) and compliance with teacher instructions (Vermetten et al., 2001), its impact on academic achievement was rather small and not always consistent across samples (e.g., Poropat, 2009).

The current research is an extension of previous studies of Caprara et al. (2004, 2008) and focus on the contribution of basic traits and self efficacy beliefs to academic performance at different stages of academic career. To this aim, we examined the unique contribution of basic personality traits and academic self-efficacy beliefs on later academic performance at the end of both junior high school and high school. Then, we examined the pathways through which traits and self-efficacy beliefs were conducive to academic performance, after the contribution of socio-economic status (SES) was partialled out. Indeed, a recent

meta-analysis of Sirin (2005) showed a medium to strong relation between SES and academic performance. Taking into account SES would minimize the possibility of spurious relations due to omitted relevant variables related to SES, like quality of educational facilities and supportive relationships among parent and school (see, e.g., Caprara et al., 2008).

In accordance with previous studies, we focused on openness and conscientiousness as the most important predictors, among the Big Five, of academic achievement. Likewise, we focused on self-efficacy beliefs which in previous studies have proved to be strongly associated to academic achievement (Bandura et al., 1996). First, we expected to corroborate the independent contribution of openness and conscientiousness traits and of academic self-efficacy beliefs to academic achievement, above and beyond the contribution of SES and across gender.

Then, we expected to corroborate the crucial role of academic achievement in nurturing self-efficacy beliefs in accordance with social cognitive theory, which posits mastery experience at the roots of self-efficacy beliefs. Finally, we expected to clarify how traits and self-efficacy beliefs contribute to academic achievement at different stages of children academic career. In particular, we advanced four sets or interrelated hypotheses:

1. We expected that traits would contribute significantly to academic performance at the end of both junior and senior high school. Based on previous studies suggesting that the importance of personality traits in sustaining academic results decrease with increasing in school level (Peterson & Whiteman, 2007), we hypothesized that the contribution of traits to academic achievement is more important at earlier stage than at later stages of scholastic career, that most reflect the influence of experience.

2. In accordance with previous findings (Caprara et al., 2008) we hypothesized that academic self-efficacy beliefs contribute significantly to academic performance at the end of both junior and senior high school. Furthermore, in accordance with social cognitive theory that posits mastery experiences and self-reflection capacities at the roots of self-efficacy, we hypothesized that the contribution of academic self-efficacy beliefs to academic achievement is most relevant at later stages (secondary school) than at an earlier stages. We reasoned that students' sense of efficacy draws from previous experience and attest to their capacity to reflect and to capitalize upon experience in order to deal effectively with school challenges. Finally, school performance at the end of junior high school was expected to contribute significantly to academic self-efficacy in senior high school.

3. In accordance with above reasoning pointing to traits as potentials and to self-efficacy beliefs as

knowledge structures enabling people to make the best use of their talents, we hypothesized that openness and conscientiousness in junior high school would contribute to later academic self-efficacy beliefs. In particular, we hypothesized that beliefs students hold about their capacity to master the various school contents and to regulate their learning activities would partially mediate the effect of earlier basic dispositions towards knowledge acquisition (openness), discipline and achievement (conscientiousness) on scholastic achievement.

4. We hypothesized that economical status would influence learning at earlier stages more than at later

stages due to the selection processes that take place at end or junior high school depending on children performance. In reality, most low SES children who fail at junior high school are unlikely to continue 5 years senior high school conducive to superior education.

5. Despite a relatively large literature documents, higher levels of academic self-efficacy beliefs for females than for males (Bandura et al., 1996; Caprara et al., 2008; Pastorelli et al., 2001), there is no evidences of an influence of gender on the relations between academic self-efficacy beliefs and other personality constructs, like traits, or school

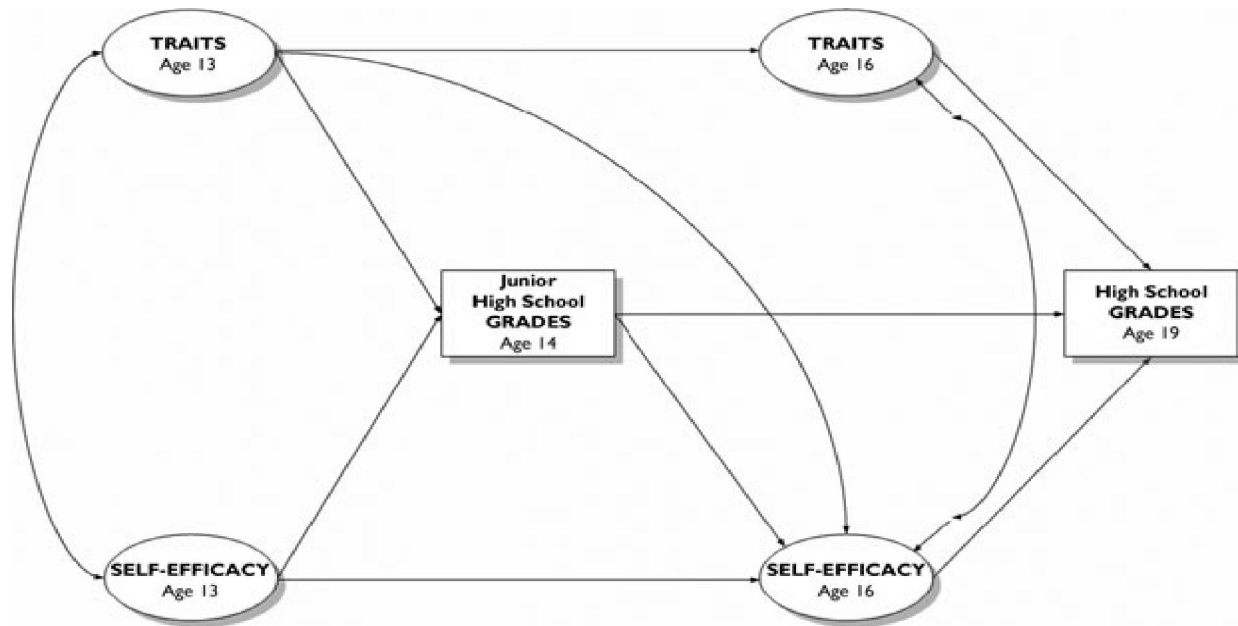


Figure 1. The posited model. The paths from socio-economic status to all other variables were omitted for sake of simplicity.

Achievement (Bandura et al., 1996; Caprara et al., 2008). Accordingly, we expected no differences between males and females in the strength of the relations among the study variables.

These hypotheses lead to posit and test a model that included (1) all the autoregressive paths; (2) the cross-lagged paths from conscientiousness and openness at the age of 13 to academic self-efficacy at the age of 16; (3) the paths from conscientiousness, openness, and academic self-efficacy beliefs at the age of 13 to junior high-school grades; (4) the paths from conscientiousness, openness, and academic self-efficacy beliefs at the age of 16 to senior high-school grades; (5) the path from junior high-school grades to high-school grades; (6) the path from junior high-school grades to academic self-efficacy beliefs at the age of 16, in

accordance with social cognitive theory that points to previous mastery experiences as the most important determinants of self-efficacy beliefs; (7) the covariance among all of the variables at the age of 13 and also at the age of 16. The posited model is shown in Figure 1. In this model, we also considered SES as time invariant covariate influencing all variables (for not cluttering the figure, the effects of SES are not represented). Although we did not expect any significant difference between males and females, we tested for possible gender differences conducting a multiple-group analysis.

The participants were 412 children, 196 boys and 216 girls, part of an ongoing longitudinal project that started in 1987 with primary goal of investigating the personal and social determinants of children and adolescents' adjustment.

This longitudinal project includes a staggered, multiple cohort design, with different cohorts assessed at different time points. The participating children were originally drawn from two junior high schools in Genzano, a residential community located near Rome. Children were re-examined every other year till the end of senior high school and thereafter. The research was approved by a school council composed of parent and teacher representatives at the junior high-school level. In addition to parents' consent, children were free to decline to take part. The current study includes two cohorts composed of students belonging to both schools and assessed at four different time points. Both cohorts were aged 13 years at time 1 (7th grade), aged 14 at time 2 (8th grade/end of junior high school), aged 16 at time 3 (10th grade), and aged 19 at time 4 (13th/end of senior high school). At times 1 and 2, the data were collected in the children's classrooms by two female experimenters. At times 3 and 4, the adolescents were contacted by phone and invited to participate in the study for which they received a small payment. The participation rate was high during the longitudinal data collection: 98% and 97% from T1 to T2 for first cohort and second cohort; 90% and 96% from T1 to T3 for first cohort and second cohort; 62% and 69% from T1 to T4 for first cohort and second cohort. Multivariate analysis of variance revealed that there were no statistically significant differences on the means of the variables of interest ( $F [7, 304] = 1.34, p = .17$ ) between the participants who provided complete data for the present study and the attrited group. Sixty-one adolescents (14.8%) dropped out of the school after the end of junior high school. Preliminary analysis revealed that adolescents who dropped out of the school had lower SES ( $r = .30, p < .001$ ). The remaining participants were enrolled in classical and scientific lyceums (53.5%), technical schools (31.6%), and professional schools (15.0%). The sample matched national data with regard to both occupational socio-economic and composition of the families (Istituto Italiano di Statistica, 2002).

All participants were assessed at four waves of data collection during the course of the longitudinal study. Measures of openness and conscientiousness and of perceived self-efficacy for academic achievement were administered at time 1, when participants were in enrolled in 7th grade of junior high school (13 years), and at time 3, when they were in enrolled in 10th grade of senior high school (16 years). Academic achievement was assessed in two critical period of school career: (1) at time 2, at the end of the junior high school (8th grade), which marked the end of compulsory education; (2) at time 4, at the end of the senior high school, before the entrance to the university.

At time 1, participants rated their openness and conscientiousness by means of the 'Big Five Questionnaire' – Children version (BFQ-C, Barbaranelli

et al., 2003). The BFQ-C contains 65 items (13 for each dimension) designed to assess the Big Five in childhood and early adolescence. In the present sample, the factor structure of the BFQ-C was examined through a principal axis factor (PAF) analyses (with Oblimin rotation). Due to the large number of items considered, we factor analysed the correlation matrix of 10 parcels, which represent aggregations of several individual items. The goodness-of-fit of the hypothesized five-factor model was assessed by the root mean square residual (RMR), which represents the average of the fitted residuals. Values lower than .08 indicates acceptable fit to the empirical data; values lower than .05 indicates an excellent fit (Hu & Bentler, 1998; 1999). The five-factor structure fitted the data (RMR = 0.01) and explained 53.97% of the total variance. The factor solution substantially replicated the typical five-factor structure of the Big Five model. Primary loadings were all higher than .80 ( $M = .87, SD = .02$ ); secondary loadings were all lower than .08 ( $M = .02, SD = .02$ ). At time 3, participants rated the same dimensions by means of the Big Five Questionnaire (BFQ, Caprara, Barbaranelli, & Borgogni, 1993; Caprara, Barbaranelli, Borgogni, & Perugini, 1993). This version contains 120 items designed to assess the Big Five in adulthood (24 for each dimension). Traits were assessed by items where participants rated the occurrence of the behaviour reported using a 5-point Likert scale ranging from 1 ('Almost never' for BFQ-C, and 'Very false for me' for the BFQ) to 5 ('Almost always' for the BFQ-C, and 'Very true for me' for the BFQ). The five-factor structure of the BFQ was examined by factor analyzing the correlation matrix of the 10 'facet' scales, designed to capture more specific aspects of the Five Factors. Factor analysis (PAF with Oblimin rotation) revealed a five-factor structure that explained 55.97% of the total variance (RMR = .01). An inspection of the pattern matrix confirmed the hypothesized five-factor model. Each pair of facets showed the highest loadings on the same factor, and lower loadings on the other factors. Primary loadings were all higher than .50 ( $M = .57, SD = .14$ ), with the exception of scrupulousness, which loaded .29 on the respective factor (conscientiousness); secondary loadings were all lower than .35 ( $M = .14, SD = .12$ ). All the Five Factors were assessed in this study, although we focused our attention on conscientiousness and openness. The conscientiousness scale measured dependability, orderliness, precision, and the fulfilling of commitments. Item samples were 'I like to keep all my school things in a great order' in the BFQ-C version, and 'Before completing a job I spend a lot of time revising it' in the BFQ version. Cronbach's alpha was .84 at time 1 and .81 at time 3. The Openness scale measured both self-reported intellect in the school domain and broadness or narrowness of cultural interests, and self-reported fantasy/creativity. Item



samples were 'I easily learn what I study at school' in the BFQ-C version, and 'I'm always informed about what's happening in the world' in the BFQ version. Cronbach's alpha was .79 at time 1 and .78 at time 3. The internal consistency coefficients of the other dimensions ranged from .72 (agreeableness) to .84 (emotional stability) at time 1, and from .71 (agreeableness) to .84 (emotional stability) at time 3.

The academic perceived self-efficacy scale included 15 items related to two broad domains of self-efficacy beliefs. The first domain referred to the perceived capability to successfully master different curricular areas (e.g., 'How well do you do in mathematics?'). The second domain concerned the perceived capacity for self-regulating learning activities, as the capacity to plan and organize the academic activities, to structure environments conducive to learning and to motivate themselves to do their school work (e.g., 'How well can you study when there are other interesting things to do?') (Bandura et al., 1996; Pastorelli et al., 2001).

### 3. Discussion

Although traits and self-efficacy beliefs have been often presented as expressions of rival views about personality functioning, above findings attest that both are crucial to account for academic achievement. In reality, individual differences in personality traits and self-efficacy beliefs have proved to play a unique and distinctive role in contributing to students' performance across different stages of academic career, in accordance with the posited hypothesis. Openness contributed to academic performance at the end of junior high school, more so than academic self-efficacy beliefs that contribute significantly to academic achievement too. One may argue that a basic trait like openness exerts its influence on academic achievement mostly at an earlier stage as a proxy of cognitive endowment fostering learning, more than self-efficacy beliefs that rest upon actual experiences and develop over time. Openness, instead, is no longer as important in senior high school where the capacity to regulate one's learning is most crucial to take advantage of one's own talents. One should also consider that the time interval between measurement of traits and academic performance in senior high school is shorter than the corresponding time interval at later stages of scholastic career. This may contribute to explain the differential effect of openness on academic achievement. Unexpectedly, conscientiousness did not contribute directly to academic achievement neither at the end of junior high school nor at the end of senior high school. Rather, it contributed to later academic self-efficacy beliefs which mediated its impact on subsequent senior academic achievement. One may argue that a basic trait like conscientiousness exerts its influence on academic

achievement by fostering self-regulatory abilities (Gerhardt, Rode, & Peterson, 2007) over the course of the scholastic career.

In accordance with our hypothesis, academic achievement at the end of junior high school significantly contributed to later perceived academic self-efficacy, while academic self-efficacy beliefs contributed to academic achievement in senior high school more so than in junior high school. This is in accordance with social cognitive theory either in viewing the capacity to learn from experience and to orchestrate own behaviour accordingly as the main determinants of self-efficacy beliefs, and in viewing self-efficacy beliefs as major determinants of motivation and achievement (Bandura, 1997, 2001). Likely confidence in one's capacity to regulate one's own learning and to manage the various scholastic activities and relations with teachers and peers is mostly crucial in senior high school to nurture the motivation needed to realize one's own potentials and to fully benefit of situational challenges.

Whereas academic perceived self-efficacy at age 16 retained its relation to academic achievement at the end of senior high school after we controlled for variations in prior academic performance and socio-economic level, the direct contribution of traits, was not significant. Yet one should not underestimate findings that support, although tenuously, the mediational role of academic self-efficacy beliefs in linking traits to academic achievement, mostly in senior high school. These findings accord with earlier findings from diverse lines of research which underline the crucial role of belief in one's capabilities in turning basic dispositions into specific behaviours (Caprara et al., 2009; Chen et al., 2001; Kanfer, 1992; Martocchio & Judge, 1997; Nauta, 2004). Finally, family SES affected academic performance directly in junior high school, and indirectly in high school, through its impact on prior academic attainment.

Above findings corroborate the posited hypotheses across gender. The posited model accounted for a substantial portion of variance at the end of both junior and senior high-school grades, namely at two important junctions of children's scholastic career and vocational choices. Thus, it deserves special attention as it may help to design proper strategies aimed to promote academic achievement while attenuating diversities due to personal and situational opportunities.

At the end of junior high-school, children examined in this study were expected to choose whether to enter the labour force and/or whether to continue school and which academic track to pursue. Whereas well-off children do better at school than poor children, mostly well-off children engage into senior high schools, like classical and scientific lyceums, that are as demanding as conducive to prestigious career in

university and in the labour market. Likely, SES is no longer so important in senior high school as it is in junior high school, due to the conspicuous abandonment of disadvantaged children. These findings have broad implications for interventions aimed to enhance children's academic pursuits. Whereas personality traits represent stable individual characteristics that mostly derive from individual genetic endowment, social cognitive theory provides guidelines for enhancing students' efficacy to manage their educational development and to regulate their learning activities (Bandura, 1997). Social cognitive theorists focus on a joint effort to raise competence and confidence primarily through mastery experiences (Pajares & Schunk, 2001). In reality, some progress has been made in translating this knowledge into operational models that foster self-directedness in academic pursuits (Bandura, 1997; Pajares & Urdan, 2006; Schunk & Zimmerman, 1994; Zimmerman, 1990; Zimmerman & Cleary, 2006). As academic self-efficacy is responsive to changes in instructional experience, teachers may play a crucial role in students' development and use of academic competencies (Pajares & Schunk, 2001; Robbins et al., 2004). Teachers that individualize and tailor classroom instruction to each student's academic abilities encourage children to estimate their progress according to their own internal standards (Pajares, 2002). Teachers and parents, who teach students how to set goals and monitor their learning progress, help to build their sense of efficacy for managing their academic activities and for taking full advantage of their potentials. Researchers have known for a long time that self-beliefs and self-regulatory habits that are developed early persevere and are more resistant to change (Pajares, 2002). Thus, educators and school administrators face the challenge of making their students' positive self-beliefs and self-regulatory strategies automatic and habitual as early as possible.

Summarizing, both traits and self-efficacy beliefs might play a major role in the promotion of academic achievement. Although basic traits may be useful for predicting school grades, relying only upon traits may be of limited value to actively promote school achievement. While children move through the various school levels, basic dispositions seem to let the way to more deliberate individuals effort to self-regulate learning and to strive to attain higher achievement. This finding may contribute to the existent literature, by providing a bridge between two main traditions of research in personality, namely trait theory and social cognitive theory, opening new directions for research aimed at better understanding how basic dispositions and potentials may turn into actual behaviours and sustain youth achievement at school.

There are potential limitations of this study which refer to the measures that were used (self-reports) and

the population examined. Perceived self-efficacy beliefs are private cognitive states that are necessarily accessible by the individuals who hold those beliefs. However, personality traits could be assessed not only through self-report. Researchers have previously found a fair degree of concordance between self- and other-reports of personality traits (Caprara, Barbaranelli, Borgogni, & Perugini, 1993). In future works it would be desirable to rely upon multiple raters to minimize bias due to self-report. Moreover, although the sample we used matched national profile with regard to basic socio-economic characteristics (i.e., occupation and composition of families), the use of students from only two schools might limit the extent to which results can be generalized. The above results need to be corroborated in different samples, as well as in different cultural contexts.

### Conclusion

Openness and academic self-efficacy at the age of 13 contributed to junior high-school grades, after controlling for socio-economic status (SES). Junior high-school grades contribute to academic self-efficacy beliefs at the age of 16, which in turn contributed to high-school grades, over and above the effects of SES and prior academic achievement. In accordance with the posited hypothesis, academic self-efficacy beliefs partially mediated the contribution of traits to later academic achievement. In particular, conscientiousness at the age of 13 affected high-school grades indirectly, through its effect on academic self-efficacy beliefs at the age of 16. These findings have broad implications for interventions aimed to enhance children's academic pursuits. Whereas personality traits represent stable individual characteristics that mostly derive from individual genetic endowment, social cognitive theory provides guidelines for enhancing students' efficacy to regulate their learning activities.

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**Table 1.** Means, standard deviations, and correlations across time among conscientiousness, openness, academic self-efficacy, and junior high and high-school grades

	M	SD	1	2	3	4	5	6	7	8
1. Conscientiousness (13 years)	3.50 (3.66)	.65 (.63)	–	.67**	.55**	.47**	.27**	.36**	.22**	.21*
2. Openness (13 years)	3.64 (3.65)	.63 (.62)	.71**	–	.57**	.38**	.54**	.43**	.40**	.40**
3. Academic self-efficacy (13 years)	3.78 (3.74)	.46 (.43)	.53**	.53**	–	.30**	.29**	.45**	.31**	.22*
4. Conscientiousness (16 years)	3.29 (3.40)	.42 (.44)	.33**	.22**	.34**	–	.49**	.49**	.29**	.29**
5. Openness (16 years)	3.27 (3.41)	.37 (.42)	.24**	.41**	.32**	.37**	–	.40**	.28**	.24**
6. Academic self-efficacy (16 years)	3.60 (3.76)	.42 (.45)	.40**	.38**	.50**	.48**	.40**	–	.44**	.34**
7. Junior high-school grades (14 years)	2.96 (3.16)	.84 (.86)	.21**	.41**	.32**	.19*	.40**	.38**	–	.40**
8. High-school grades (19 years)	72.51 (78.76)	14.20 (12.72)	–.05	.06	.07	.15	.14	.30*	.37**	–

Note. Means and standard deviations for females are reported in parentheses. Correlations for females are above the diagonal; correlations for males are below the diagonal. \* $p < .05$ ; \*\* $p < .01$ .

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## Modified Fermi-Gas Model to Calculate the Nuclear Quantities

Marziyeh Reshadatiyan<sup>1</sup>, Mohammad Javad Tahmasebi Birgani<sup>2</sup>, Fereshteh Ghasemi<sup>3</sup>, Iraj Kazeminejad<sup>4</sup>

<sup>1</sup> Department of Physics, Science and Research Branch, Islamic Azad University, Khuzestan, Iran

<sup>2</sup> Department of Medical Physics and Radiation Therapy, Jundishapur University of Medical Sciences, Ahwaz, Iran

<sup>3</sup> Department of Electrical Engineering, Payame Noor University, 19395-4697, Tehran, Iran

<sup>4</sup> Department of Physics, Shahid Chamran University, Ahvaz, Iran

[M.Reshadatian@yahoo.com](mailto:M.Reshadatian@yahoo.com)

**Abstract:** Due to the unknown nature of nuclear forces, using nuclear models for different purposes of nuclear usage, as explanation of the interactions between nuclear particles are remarkable. In this study, by introducing a density and nucleus parameterization; we modify the Fermi gas model, and calculate nuclear quantities based on the modified model. For the first time, according to properties of the nuclear density, we consider it as an error function, then, parameterize nuclear density based on the known properties of nucleus. According to the modified Fermi gas model, we calculate quantities of density, radius and find the relationship between them. Then, we calculate the surface thickness of the nucleus and the nucleus radius, average radius of the nucleus, volumetric energy, surface energy and the Coulomb energy with the Pauli correction effect, asymmetric energy of nucleons, the nuclear compressibility; binding energy is obtained using outcomes too. At last Coefficients of Binding Energy is compared with previous studies; the result of formulation and error in the Tablecurve software shows that error calculated by the program was too little so we concluded that the formula presented to calculate the nuclear energy is appropriate to interpret nuclear properties.

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**Keywords:** Nuclear quantities; Fermi gas model; Nucleus density; Error function.

### 1. Introduction

Nuclei have a certain time-independent properties such mass, size, charge, intrinsic angular momentum and certain time-dependent properties such as radioactivity and artificial transmutations (nuclear reactions). The mass of a nucleus is related to the mass summation of the protons and neutrons which constitute it and nuclear binding energy is the energy required to split a nucleus of an atom into its component parts (Serway and Vuille, 2010); the binding energy is also reduced by Coulomb repulsion forces between the protons (Jevremovic, 2009). The electron scattering experiment could reliably use for measuring nuclear radius (Povh, 2008). The nucleon density distribution has been measured in scattering experiments too (Sitenko and Tartakovskii, 1977); heavy nuclei have a uniform central density, surrounded by a diffuse surface region. The shape of the nucleon density distributions (Woods-Saxon distributions) is described by a Fermi function. A Woods-Saxon distribution is an accurate one as its nuclear potential does not have a sharp edge as indicated by Moharram et al. (1980), and Srokowski et al. (1995).

The nuclear force (nucleon-nucleon interaction) is very powerful, but extremely short-range; the range of the nuclear force is  $< 2$  fm (Bolonkin, 2009). There are many different nucleus

models that scientists have used to explain the nature of the nuclear force in order to employ of nuclear energy since 1934 (Sutton, 1992); to this day proposed models can not completely alone explain all nuclear properties. These models include some that are based on the three phases of ordinary matter: solid, liquid, and gaseous, and some that are based on atomic molecules. One of an independent particle models is Fermi gas model (semi-classical); due to the lack of experimental data, this model is still not completed. However it is a statistical model of the nucleus; this model pictures the nucleus as a degenerate gas of protons and neutrons as nucleons move freely inside the nucleus (Sharma, 2008).

In the present study we modified Fermi gas model considering effect of the nuclear surface and calculate the surface thickness of the nucleus and the nucleus radius, average radius of the nucleus, kinetic energy and the Coulomb energy with the Pauli correction effect, asymmetric energy of nucleons, the nuclear compressibility and binding energy based on the modified model as well as comparing the findings with results of other studies.

### 2. Material and Methods

Due to the different approximations for the nuclear density, Woods-Saxon distribution considered more accurate than other approximations.

This function should be expressed by series in order to use in calculations; consequently, it would be more complicated. So firstly we introduce a simple function which is similar to this distribution curve and represents nuclear density; finally nuclear quantities will be calculated using this novel function. The error function is suggested for nuclear density and is defined as follows (Weber et al., 2003):

$$[1 - \text{erf}(x)] = \left[ 1 - \frac{2}{\sqrt{\pi}} \int_0^x e^{-u^2} du \right] \quad (1)$$

Figure 1 presents error function, this graph plots in Matlab Software. For similarity between Woods-Saxon distribution and 1-erf(x) curves, we ourselves propose density function as the follows:

$$\rho(x) = \rho_0 \left[ 1 - \frac{2}{\sqrt{\pi}} \int_0^x e^{-u^2} du \right] \quad (2)$$

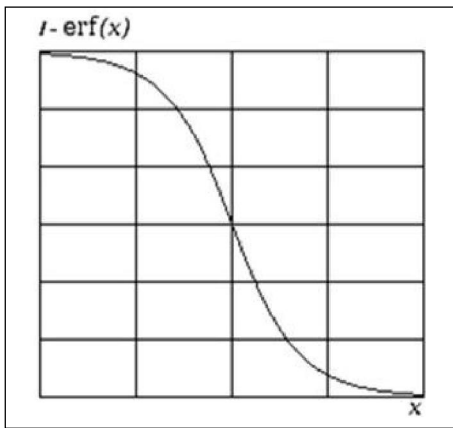


Figure 1.  $[1 - \text{erf}(x)]$  curve is similar to Woods-Saxon distribution

**2.1 The average radius of the nucleus**

Radius of the nucleus can be calculated from the knowledge of mass number (Hobbie et al., 2007) and accordingly density, so in the following equation  $\rho_0$  is the density where  $\bar{R}$  is the average radius of the nucleus and we have:

$$\bar{R} = \langle r \rangle = \frac{\int \rho(r) r dv}{\int \rho(r) dv} \quad (3)$$

After substituting Eq. (2) in Eq. (3) and solving integrals by the Derive 6 software,  $\bar{R}^3$  is obtained as:

$$\bar{R}^3 = 1.66(\bar{R})^3 \quad (4)$$

**2.2  $\rho_0$  in density function**

Since in the Fermi gas model, we consider nuclear shape as spherical (Wong, 2004); in calculating  $\rho_0$  the volume of a sphere is used:

$$A = \int_0^\infty \rho(r) dV \quad (5)$$

After substituting Eq. (2) in Eq. (5) and solving integrals,  $\rho_0$  will be  $3\rho$ .

If we consider Hauser-Feshbach nuclear density which is  $\rho = 1/72 \times 10^{38}$  we have:

$$\rho_0 \cong 0.52 \text{ Particle / cm}^3 \quad (6)$$

**2.3 The average kinetic energy of a nucleon**

Number of counted balances in interval  $k$  to  $k+dk$  at momentum space ( $k$ ) is obtained by:

$$dn(k) = \frac{1}{8} (4\pi k^2 dk) \frac{1}{\left(\frac{\pi}{a}\right)^3} \quad (7)$$

To modify this model, counting balances on three surfaces  $k_x = 0, k_y = 0, k_z = 0$  (Surface effect) and counting balances on axis (linear effect), should be moved out of the volume.

Surface linear effect is defined:

$$\frac{1}{2} \frac{dk}{\left(\frac{\pi}{a}\right)} \quad (8)$$

By substitution volume and surface area formula of sphere, the correct counted balances in momentum space are obtained:

$$dn = (0.36(\bar{R})^3 k_F^2 - 0.4(\bar{R})^2 k_F - 0.45\bar{R}) dk \quad (9)$$

According to the Pauli exclusion principle which illustrate state of electrons in the same orbit, (Godse and Bakshi, 2009) we have:

$$\int dn(k) = \frac{A}{4} \quad (10)$$

By substitution Eq. (9) in Eq. (10) and solving the integral we obtain:

$$A = 0.48(\bar{R})^3 k_F^3 - 0.8(\bar{R})^2 k_F^2 - 1.8\bar{R} k_F \quad (11)$$

For Average kinetic energy of the nucleons we can use this formula:

$$\left\langle \frac{E}{A} \right\rangle = \frac{\int_0^{k_F} \varepsilon(k) \frac{dn(k)}{dk} dk}{\int_0^{k_F} dn(k)} \quad (12)$$

Where

$$\varepsilon_F = \frac{(\hbar k_F)^2}{2M} \quad (13)$$

Eq. (13) is fermi energy of the last balance.

After solving the integral respect to  $k_F$  we have:

$$\left\langle \frac{E}{A} \right\rangle = E_F \left( 0.6 + \frac{0.17}{X} + \frac{1.27}{(X)^2} \right) \quad (14)$$

Based on the results of Feshbach calculations, Experimental value for  $k_F \cong 1.4 \text{ fm}^{-1}$

and  $E_F$  will be  $40 \text{ MeV}$  where  $M$  is the proton mass.

Kinetic energy in Eq. (14) can be obtained as a function of  $A$  in Eq. (11). For this we use change of variable  $X = \bar{R}k_F$  and approximation method to solve the problem which is  $X = y + 0.55$  and the other one  $y(y^2 - 3.6) = 2A + 2.4$ . This equation can be solved using Cardan method too (Nickalls, 2008). For nuclei with different Nucleons numbers, we put  $y$  and  $X$  values in Table 1.

Table 1. Values of the third-order in Eq. (11)

A	Y*	X*
27	4.2	4.75
64	5.3	5.85
125	6.5	7.05
216	7.7	8.2
342	7.8	9.5

Values calculated in solving the third order equation (Eq. (11)) for different numbers of nucleons were inserted in the software Tablecurve shows in Figure 2 and amid numerous formulas, a formula that had the lowest standard error was determined that is:

$$\bar{R}k_F = 2.08 + 0.7A^{0.4} \quad (15)$$

We know (Bartke, 2009):

$$R = R_0 A^{\frac{1}{3}} \quad (16)$$

And in Fermi gas model  $k_F \cong 1.4 \text{ fm}^{-1}$  so by substituting in Eq. (15),  $R_0$  can be calculated as a function of  $A$ :

$$R_0 = 1.48A^{-1/3} + 0.5A^{0.07} \quad (17)$$

Furthermore, by inserting  $\bar{R}k_F$  and  $R_0$  values in Eq. (14) we have:

$$\left\langle \frac{E}{A} \right\rangle = E_F \left( 0.6 + \frac{0.17}{2.08 + 0.7A^{0.4}} + \frac{1.27}{(2.08 + 0.7A^{0.4})^2} \right) \quad (18)$$

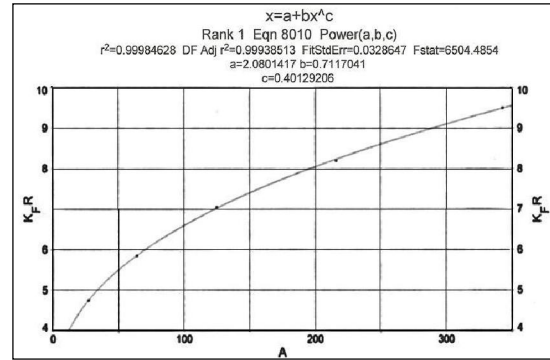


Figure 2. Graph of  $K_F \bar{R}$  as a function of  $A$

### 2.4 The Coulomb energy

The shape of the nucleus is determined mainly by three factors, the volume energy, the surface energy, and the coulomb energy (Aruldas and Rajagopal, 2005); Nuclear Coulomb energy according to the Pauli Exclusion Principle is obtained by:

$$C.E = \frac{A(A-1)}{2} \times \int \bar{\rho}_{00}(r_1, r_2) v_{12}(r_1, r_2) dr_1 dr_2 \quad (19)$$

Where

$$v_{12} = \frac{e^2}{r_{12}} \left[ \frac{1 + \tau_3(1)}{2} \right] \left[ \frac{1 + \tau_3(2)}{2} \right] \quad (20)$$

After putting the proposed density function in the formula, the integral equation is split into two separate integrals; the first integral gives classical Coulomb energy of a sphere; the second integral gives corrections of the Pauli principle on the nuclear Coulomb energy.

The answer to the first integral for  $Z \gg 1$  is:

$$C.E = 0.65 \frac{Z^2 e^2}{R} \quad (21)$$

And the solution for the second integral is:

$$(C.E)_{ex} = \frac{9\pi z^2 e^2}{4 \Omega k_F^2} \quad (22)$$

And finally total coulomb energy is:

$$C.E = \frac{3}{5} \frac{Z^2 e^2}{R} - (C.E)_{ex} \quad (23)$$

By substitution Eq. (22) in to Eq. (23) we can write:



$$C.E = 0.83 \frac{Z^2}{A^{\frac{1}{3}}} \left( 1 - \frac{1}{\frac{2}{A^{\frac{2}{3}}}} \right) \quad (24)$$

### 2.5 The asymmetry energy

Asymmetry energy (also called Pauli Energy) is an energy associated with the Pauli Exclusion Principle. To calculate this energy it is sufficient to calculate the energy difference between two symmetry and asymmetry nucleus. So by assuming  $E_F \cong 40 \text{ MeV}$  In the following expression  $\frac{N-Z}{A}$  is called neutron excess ratio which decrease nuclear stability (Singh, 2008).

We have:

$$\Delta E = \frac{1}{3} \frac{\varepsilon_F (N' - Z')^2}{A} \cong 1.32 \frac{(N' - Z')^2}{A} \text{ Mev} \quad (25)$$

### 2.6 The binding energy

Nuclear energy is the summation of kinetic energy and the binding energy of the nucleus that is  $\langle U \rangle = \langle T \rangle + \langle B.E \rangle$ ; as we know  $\langle U \rangle \cong 40 \text{ MeV}$

Consequently, the whole binding energy is obtained using U and T which was calculated lately (Eq. (18)), and by subtracting relations of the Coulomb energy, asymmetry energy and the coupling energy we can write the following equation,

$$\langle B.E \rangle = 16A - \frac{6.8A^{\frac{2}{3}}}{2.08A^{\frac{1}{3}} + 0.7A^{0.07}} - \frac{50.8A^{\frac{1}{3}}}{(2.08A^{\frac{1}{3}} + 0.7A^{0.07})^2} - 0.83 \frac{Z^2}{A^{\frac{1}{3}}} \left( 1 - \frac{1}{\frac{2}{A^{\frac{2}{3}}}} \right) - 1.32 \left( \frac{N' - Z'}{A} \right)^2 \pm \gamma \quad (26)$$

### 2.7 The Nuclear compressibility

The curvature of the shape of the volume energy as a function of the density in the vicinity of the equilibrium value defines the nuclear compressibility K (Hornyak, 1975):

$$K_{Com} = R_0^2 \frac{\partial^2 E}{\partial R_0^2} \quad (27)$$

We can write Eq. (15) in form of:

$$K_F = \frac{f(A)}{R_0} \quad (28)$$

By substitution Eq. (28) in to Eq. (14) we have:

$$\langle E \rangle = \frac{\hbar^2}{2M} \frac{f^2(A)}{R_0^2} \left( 0.6 + \frac{0.17}{X} + \frac{1.27}{(X)^2} \right) A \quad (29)$$

In Eq. (29) by taking two derivatives with respect to  $R_0$ , considering  $E_F \cong 40 \text{ MeV}$  and substitution in Eq. (27) we obtain:

$$K_{Com} = 144A + \frac{40.8A^{\frac{2}{3}}}{2.08A^{\frac{1}{3}} + 0.7A^{0.07}} + \frac{304.8A^{\frac{1}{3}}}{(2.08A^{\frac{1}{3}} + 0.7A^{0.07})^2} \quad (30)$$

While Berg and Lawrence's achieved relation for  $K_{Com}$  is  $125A + 210A^{\frac{2}{3}}$  (Berg and Wilets, 1956).

Finally considering Eq. (27), the compressibility of nuclear is:

$$b_{Com} = 16A + \frac{4.53A^{\frac{2}{3}}}{2.08A^{\frac{1}{3}} + 0.7A^{0.07}} + \frac{33.86A^{\frac{1}{3}}}{(2.08A^{\frac{1}{3}} + 0.7A^{0.07})^2} \quad (31)$$

### 2.8 The nuclear electric quadrupole moment

The nuclear electric quadrupole moment is a parameter which describes the effective shape of the ellipsoid of nuclear charge distribution (Cottingham and Greenwood, 2001).

The nuclear electric quadrupole moment is defined as:

$$Q = K_C \int \frac{r^2}{2} (3 \cos^2 \theta - 1) \rho dV \quad (32)$$

Note that the nucleus assumed spherical, now we write spherical polar coordinates for Eq. (32):

$$Q = \int_0^r \int_0^\pi \int_0^{2\pi} \frac{K_C r^2}{2} (3 \cos^2 \theta - 1) \rho r^2 \sin \theta d\theta d\phi dr = 0 \quad (33)$$

As it is obvious the calculated value is equal to zero, Of course the above integral was expected, because the nuclear electric quadrupole moment depends on the nucleus shape and it's symmetric and asymmetric with respect to axes and in this spherical shell nuclear model the nuclear electric quadrupole moment is equal to zero due to symmetry of the sphere with respect to axes (McParland, 2010).

### 2.9 The Thickness of the nuclear surface

The surface thickness is defined to be the change in radius required to reduce  $\rho(r)/\rho_0$  from 0.9 to 0.1 ( $\rho_0$  is the density in the center of the nucleus).

Using Eq. (2) the following result are obtained by Derive 6 software; if we consider:

$\rho(x) = 0/9\rho_0$  So we have  $x = 0.088$ , and for  $\rho(x) = 0/1\rho_0$  we have  $x = 1.163$

On the other hand, as regards  $X = \alpha r$  and  $\bar{R} = \frac{1}{\alpha}$  so the surface thickness will be:

$$t = R_2 - R_1 = \frac{1.163 - 0.088}{\alpha} = 1.075R_0A^{\frac{1}{3}} \quad (34)$$

As a result, the thickness of the nuclear surface is obtained as a function of A using Eq. (17):

$$t = 1.59 + 0.53A^{0.4} \quad (35)$$

In Table 2 we calculated the thickness of the surface for a number of heavy and semi-heavy nuclei with respect to the relation obtained for surface thickness of the nucleus.

Table 2. Surface thickness value for heavy and semi-heavy nuclear obtained by Eq. (35)

Nucleus	t* (fm)
${}_{26}^{56}Fe$	4.24
${}_{33}^{75}As$	4.57
${}_{38}^{88}Sr$	4.76
${}_{54}^{130}Xe$	5.3
${}_{82}^{206}Pb$	6.05
${}_{92}^{238}U$	6.32

### 3. Results

The calculations result of the nuclear quantities was showed in this project. Among the proposed models, the Fermi gas model as a selected model in this project is a proper model for calculating the properties and factors of nucleus.

The advantage of this model is that by investigating variety of approximation for nuclear density, we could introduce a function (Error function) for the nucleus density, and with employing it; we could find, firstly, a relation for the average radius  $\bar{R}$  with respect to  $\alpha$ , which is a coefficient of the nucleus radii ( $X=\alpha r$ ) also, we calculated  $\bar{R}^3$ .

We could find  $\rho_0$  in the proposed density function (nuclear density, when the nucleus radius is equal to  $\bar{R}$ ). We obtain the average kinetic energy of the nucleons with respect to A; after that we gain binding energy by reducing surface effects, asymmetry, Coulomb and coupling of nucleons.

In binding energy, the term with coefficients A is the volume energy term; the term with a coefficient  $A^{\frac{2}{3}}$  is the surface energy term; and the term with a coefficient  $A^{\frac{1}{3}}$  is the radial. The next term

is the Coulomb energy; then, asymmetry energy; and  $\gamma$  is the coupling energy. By different values for A, we collect values X, and Y in Table 1. And then, best curve fit to the data which is shown in Figure 2, is plotted using the Tablecurve software.

### 4. Discussions

Considering the calculated surface thickness values, it can be seen, this quantity can be increased by increasing the number of nucleons. Based on the binding energy significance in splitting a nucleus of an atom into its component parts; a comparison of experimental and theoretical of binding energy coefficients of this study with others has shown in Table 3. This table show, the volumetric energy coefficient values which have been calculated in this study is very close to values obtained by others. Surface energy coefficient calculated in the present study is as a function of the nucleon number of the nucleus (A) while other studies have obtained a constant numerical value for this coefficient. With paying more attention in the binding energy formula, it can be seen that this relation has a term A-dependent compared to the relations calculated by others and the result will be a modified Fermi gas model for nucleus. A comparison between the nuclear compressibility calculated in this study and the results of others indicate that there has not been found an experimental procedure for the determination of this quantity until now; however Berg and Wilets (1956) obtained the relation

$K_{com} = 125A + 210A^{\frac{2}{3}}$ , Brueckner and Gammel (1958) achieved  $k=172$ , Molitoris and Stöcker (1985) attained  $k=380\text{MeV}$ , Danielewicz (1994) acquired  $k=215$ , and we obtained the value of  $k=148$  for  $A=100$  based on Eq. (30). Results of formulation and partial error in the Tablecurve software show minor error and indicates the formula presented to calculate the nuclear energy is appropriate; so that By finding a relation for the nuclear fixed radius amount  $R_0$  with respect to atomic number, we can calculate the mean radius of the nuclear, the volumetric energy, surface energy, and coulomb energy along with the Pauli effect, asymmetry energy of nucleons, compressibility of nuclear and Fermi energy. The advantage of this method is that it can calculate the entropy and the thermodynamics of nuclear will be achieved consequently; we will consider calculation this for our future work. In future relativistic case can be discussed and evaluated; nucleus can consider in adiabatic state and thermodynamic calculations can be carried out on the basis of this assumption; also as we assumed two-particle interacts in here (proton - proton or protons - neutrons or neutrons - neutrons), in future three-particle interacts (protons - neutrons -

neutrons) also can be studied in order to find modified quantities. Regarding the fact that fossil fuels are coming to an end soon, the use of nuclear

energy for peaceful purposes is getting a big deal of attention (Esrafilian and Maghamipour, 2012).

Table 3. Coefficients of binding energy formula (semi-empirical formula of mass) based on the various theories and experiment.

Ref.	$a_v (MeV)$ Coefficient of volumetric energy	$a_s (MeV)$ Surface energy coefficient	$a_c (MeV)$ Coulomb energy coefficient	$a_{asym} (MeV)$ Asymmetry energy coefficient			
(Green and Engler, 1957)	-15.58	17.23	0.698	23.3			
(Brueckner et al., 1961)	-15.642	19.23	20	0.727			
(Myers and Swiatecki, 1966)	-15.68	18.56	7.17	28.1			
(Wang and Hwang, 1972)	-15.68	18.56	0.717	1.79			
(Seeger and Howard, 1976)	-15.25	17.07	33.16	1.22			
(Sapershtein and Khodel, 1977)	-14.9	19	30,3	1.17			
(Fewell, 1995)	14	-13	-0.585	-19.3			
(Yang and Hamilton, 2010)	15.8	-18.3	-0.72	-23.2			
<b>Current study</b>	16	-6.8f(A)	-0.83	-1.32			

#### Corresponding Author:

Dr. Marziyeh Reshadatiyan  
Department of Physics  
Science and Research Branch  
Islamic Azad University, Khuzestan, Iran  
Email: [M.Reshadatian@yahoo.com](mailto:M.Reshadatian@yahoo.com)

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