PROXIMATE COMPOSITION AND QUALITY ATTRIBUTES OF MILK SUBSTITUTE FROM MELON SEEDS (CITRULUS VULGARIS SCHRAD)

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Abstract: Vegetable milk was produced from melon seeds by boiling 20g of the seeds in100ml distilled water for 1h using a water bath, after which the resultant slurry was cooled to 28 ^{o}c and then filtered using ultra filtration (UF) membrane process. The percentage yield was 80.6% and the milk has characteristic white colour, specific gravity of 1.002, pH of 6.8 and titratable acidity of 0.70% (as lactic acid). The protein, crude fat, ash, soluble carbohydrates and moisture contents were determined to be 1.3%, 3.09%, 1.62%, 5.79%, and 88.2% respectively. Atomic absorption and flame emission spectrometry showed that the milk substitute is well buffered in minerals: calcium (92mg/100g), Phosphorous (197mg/100g), magnesium (16mg/100g), potassium (68mg/100g), sodium (3.7mg / 100g), zinc (3.8mg/100g), (copper 0.60mg/100g), magnesium (1.93mg/100g) and iron (6.34mg / 100g). The milk substitute is comparable to natural milk in colour, pH and trace mineral composition. Its sensory evaluation revealed that the milk is comparable to cow's milk in colour but inferior in taste and flavor.
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1. Introduction

Milk has been defined as a white fluid produced by the mammary gland of mammals. It is an excellent source of minerals, particularly calcium and phosphorus which form bulk of the elements in the bone. The level of phosphorus generally varies inversely to that of calcium with a molar ratio of 1:7. Most of the trace elements are also present in milk at minute levels (Zinc, copper, iron, iodine, fluorine and selenium) and they perform several vital body functions as catalyst, activators and regulators (IDF, 2008).

The term imitation milk has been used to describe as products that resemble natural milk but contain neither milk fat nor other important dairy ingredients. The use of the term imitation with its negative connotation is no longer a legal requirement (Norman, 1973). Presently, it is possible to manufacture fluid milk substitute of truly excellent quality. Generally, such products are made from skim milk or reconstituted skim milk powder plus coconut fat or some other vegetable fat. Commonly, additional ingredient such as mono- or di- glyceride emulsifier and vitamin D are added. The products are pasteurized, homogenized, packaged and marketed quite like normal milk. The acute shortage of good quality protein especially those of animal region has given place to intensive research in the production and utilization of some sources of vegetable protein notably soybean with a view to increasing their utilization (Aworh, Adedeji and Nwanekezi, 1987). Thus, soybean milk has been developed and is sold in countries in Asia, Latin America and Africa (Johnson and Snyder, 1976; Norman, 1973). This study was undertaken to look into the possibility of utilizing melon seeds as a source of milk fluid substitute vis – a- vis its proximate and sensory qualities.

2. Materials and Methods

2.1 Preparation of milk from melon seeds

Dry melon seeds (Ctrullus vulgaris Schrad) of proximate composition (on dry weight basis). Carbohydrate (10.1%)), Protein (32.6%), Fat (50.2%), Ash (3.4%) and moisture (12%) was obtained from a local market in Ibadan, South West Nigeria. Twenty grams (20g) of the seeds was boiled in100ml distilled water in a 500ml beaker for 1h using a laboratory water bath (Uniscope model). The slurry obtained was cooled to 28 ^{o}c and subjected to ultra filtration (UF). The percentage yield was estimated using the formula, **filterate x 100/slurry.**

2.2 Proximate analysis of milk

The moisture content of the milk from melon seeds was determined by the hot air oven method and the fat content by soxhlet extraction as described by Pearson (1978). The protein and Ash contents of the milk were determined by the analytical methods of Association of Analytical Chemist (AOAC, 2008) and carbohydrate content was calculated by difference (Kamel deMan and Blackman,1992)

2.3 Determination of minerals

Mg, Zn, Cu, Fe and Mn were separately determined using individual hollow cathode lamp by atomic absorption spectrometric (AAS) method

(AOAC, 2008). Na, K and Ca were separately determined by atomic absorption spectrometric (AAS) method (AOAC, 2008) using Jenway Flame Photometer. Phosphorus was determined by the venando-Molybdenate colorimetric method (Hanson, 1950).

2.4 Determination of physiochemical constants

Specific gravity was determined using two dry specific gravity bottles which were weighed empty and filled with water and melon milk respectively. The specific gravity was calculated as the ratio of the weight of a given volume of water to the weight of equal volume of melon milk.

2.5 Titratable Acidity

Titratable acidity was determined on a 10ml sample of melon milk and titrated with 0.1M sodium hydroxide, using phenolphthalein as indicator. The titrable acidity was calculated as percentage Lactic acid

2.6 pH Determination

P^H was determined by standardizing the pH meter (pH100 and pH110) with buffer solutions pH 4, 9 and the pH of the milk determined.

Table 1:
Proximate Composition of Milk from Melon Seeds

Parameter	**%**
Moisture	88.20 ± 0.05
Crude protein	1.30 ± 0.00
Crude fat	3.09 ± 0.10
Ash	1.62 ± 0.05
Carbohydrate by difference	5.79 ± 0.50

Values are mean of triplicate determinations

Table 2:
Mineral composition of milk from melon seeds

Bulk mineral	**mg /100g of milk**
Calcium	92.0 ± 5.0
Phosphorous	197.0 ± 2.5
Magnesium	16.0 ± 2.5
Potassium	68.0 ± 4.5
Sodium	3.7 ± 0.4

Values are mean of triplicate determinations

Table 3:
Trace elements in milk from melon seeds.

Trace Elements	**Concentration (ppm)**
Copper	0.61 ± 0.01
Zinc	3.80 ± 0.40
Manganese	1.93 ± 0.45
Iron	6.34 ± 0.35

Values are mean of triplicate determinations

2.7 Total solids

Total solids was determined by evaporating 10ml of the milk on a water bath at 80 ^{0}c for 1h and the solid obtained dried to constant weight in a hot oven, cooled to room temperature of 28 ^{0}c (Pearson, 1978).

2.8 Sensory Evaluation

Freshly prepared cow milk (control) and melon milk (experimental) were coded as follows: cow milk=100, melon milk=200, sweetened melon milk=300 and subjected to sensory evaluation by a randomly selected nine-member panel of biochemistry students in the department of Biochemistry. The milk samples were rated on a standard nine-point hedonic scale (1= dislike extremely and 9= like extremely) and the results were subjected to a multiple comparison difference analysis (Larmond, 1997).

3. Results and Discussion

Table 4:
A Comparison of mineral composition of cow milk and melon seed milk

Bulk Mineral	cow milk (mg /100g)	melon seed milk (mg/100g)
Calcium	120.0	92.0
Phosphorous	87.0	197.0
Magnesium	10.0	16.0
Potassium	148.0	68.0
Sodium	45.0	3.7

Source: French Dairy Board (2008). Minerals in milk and milk products

Table 5:
A Comparison of trace elements in cow milk and melon seed milk

Bulk Mineral	cow milk (ppm)	melon seed milk (ppm)
Copper	0.62	0.61
Zinc	3.54	3.80
Manganese	4.09	1.93
Iron	8.51	6.54

Table 6:
A Comparison of proximate composition of cow milk and melon seed milk

Parameter	cow milk (%)	melon seed milk (%)
Moisture	87.10	88.20
Crude protein	3.30	1.30
Crude fat	3.90	3.09
Ash	0.70	1.62
Carbohydrate (Lactose)	5.0	5.79

Table 7
A Comparison of physico-chemical constants in cow milk and melon seed milk

Parameter	cow milk	melon seed milk .
P^H	6.8±	6.4-6.8 ±
Specific gravity	1.002±	1.032±
Total solids	11.80±	13.4±

Source: Pearson, D (1976)
Composition of milk

Table 8:
Sensory scores of cow milk and melon milk

Milk	Colour	Taste	Flavour
Cow milk	8.4±	8.2±	8.9±
Melon milk	7.7 ±	5.3 ±	5.9±
Melon +Lactose	4.1 ±	5.7 ±	5.4±

The proximate composition of melon milk is shown in Table 1. The proportion of water in melon milk (88.0%) is almost the same with that of cow milk (87.1%). Generally the moisture content of milk affects the concentration of other nutrients present in it and ultimately the specific gravity. This explains the similarity in the specific gravity of cow milk (1.032) and that of melon milk ((1.002) evaluated in this study.

The mean crude protein content of melon milk (1.30%) is lower than that of cow milk (3.30%) and is responsible for the buffering effect and pH (6.8) of melon milk.. The relative low protein content of melon

milk is probably due the method of extraction employed in this study considering the fact that melon seed has a high level of protein (32.6%) (Oyenuga and Fetuga, 1975). Nonetheless, it is not the quantity of protein in milk that is important, rather the amino acid composition. Fat and carbohydrate in food samples are good sources of energy. The fat and carbohydrate contents of the melon milk (3.09% and 5.79% respectively) and that of cow milk (3.90% and 5.0 respectively) are close in values and are sufficient as sources of energy without the need to fall on protein as an energy source.

The main minerals present in melon milk are shown in Table 2. They include calcium (92mg/100g), Phosphorous (197mg/100g), magnesium (16mg/100g), potassium (68mg/100g), sodium (3.7mg / 100g), zinc (3.8mg/100g), (copper 0.60mg/100g), magnesium (1.93mg/100g) and iron (6.34mg / 100g) (Table 4). Calcium and phosphorous are required for bone formation both in infant and adult, for cell membrane permeability, for blood coagulation and muscle response. The calcium–phosphate ratio of melon milk is low, and this does not favour the proper utilization of calcium) McGilvery and Gerald, 1979). The Ash content of melon milk (1.62%) differs greatly from that of melon milk (1.09%) and this probably accounts for the variations in the mineral contents of both milks (Table 4).

The trace elements present in melon milk are shown in table 3 and compare favourably with those of cow milk with the exception of manganese. Sensory evaluation using hedonic differences scores (Table 8) shows that melon milk is comparable with cow milk in colour but inferior in taste and flavor. Sweetened melon milk is also inferior to unsweetened melon milk. However, sweetening with lactose seems to improve the flavor of melon milk

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