Effect of Sodium Metabisulphite and Disodium Ethylenediaminetetraacetic acid (EDTA) on the Stability of Ascorbic Acid in Vitamin C Syrup.

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Abstract: Vitamin C syrups of different compositions of overage (additional quantity of ascorbic acid), sodium metabisulphite and disodium ethylenediaminetetraacetic acid (EDTA) were produced. The ascorbic acid content of vitamin C syrup that contained 10%, 25%, 50% (w/v) overages was estimated to evaluate ascorbic acid stability. The effect of sodium metabisulphite in the percentage of 0.05% and 0.5% (w/v) and disodium ethylenediaminetetraacetic acid (EDTA) in the percentage of 0.0025% (w/v) was also investigated. The results of the analysis show that overages did not contribute significantly to the stability of ascorbic acid in the vitamin C syrup. However, the addition of 0.5% and 0.0025% (w/v) of sodium metabisulphite and disodium EDTA respectively in the syrup contributed significantly to the stability of ascorbic acid in the syrup.
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Key words: ascorbic acid; sodium metabisulphite; disodium EDTA; Vitamin C syrup

1. Introduction

Ascorbic acid is a derivative of carbohydrates (Sharma, 2006). The important sources of ascorbic acid are fresh fruits and fruit juices with blackcurrant, green leafy vegetables, liver and fresh milk (Martin, 1999). Ascorbic acid is needed for growth and repair of tissues in all parts of the body. It helps the body make collagen, an important protein used to make skin, cartilage, tendons ligaments, and blood vessel. Ascorbic acid is an essential and water-soluble vitamin which implies it cannot be synthesized and stored in the body (Martin, 1999). Therefore, the body gets the required vitamin C from fruits, vegetables and food supplements. Furthermore, ascorbic acid is a strong reducing agent and easily undergoes oxidation reaction which can be accelerated by light and heavy metals (Bristish Pharmacopoeia, 2009). It is stable in a dry state but unstable in a solution, especially in an alkaline solution. It readily undergoes oxidation on exposure to air (Kibbe, 2000; Touitou et al., 1992)

Sodium metabisulphite is a compound containing charged molecule of sulphur compounded with oxygen. It is used as antioxidant preservative in food and drugs (Warner et al., 2000). Sodium metabisulphite is commonly used to stabilize wine or beer and active pharmaceutical ingredients. When added to these products, sodium metabisulphite releases sulphur dioxide gas which prevents oxidation and inhibits the growth of yeasts and fungi (Foulke et al., 1993). Sodium metabisulphite is used in acidic preparations. The antioxidant of Sodium metabisulphite is usually aided by the addition of synergetic agents, whose role is to form complexes of heavy metals catalysing the oxidation processes. The common synergetic agents are: EDTA, salicyclic acid, citric acid, tartaric acid and malic acid (Marzena et al., 2011).

Ethylenediaminetetraacetic ion (EDTA) is a chelating agent used to treat metal poisoning (Raymond, 2005). It is a potentially hexadentate, coordinates as the anion with oxygen from each ionized carboxylic group and two nitrogen atoms (Ronald et al., 2005; Raymond, 2005). EDTA is an important industrial complexing agent. It forms a very stable complex with metal (Kari, 1995).

Vitamin C syrup is a drug supplement. It undergoes degradation at a fast rate due to some factors such as nature of the base (Stone, 1950), concentration of water present in the preparation (Emese et al., 2008), presence of certain metals which include Fe, Cu, Ca etc (Emese et al., 2008), and the conditions of storage such as light, temperature and containers (Subrahmaanyam et al., 1957). The use of 0.01% (w/v) sodium metabisulphite only has shown to be ineffective in stabilizing ascorbic acid in the vitamin C syrup. This challenge which was usually encountered in Sewell Pharmaceutical Limited, Sango-Ota, Ogun State, Nigeria led to investigating the effect of higher percentage of sodium metabisulphite and disodium EDTA on the stability of ascorbic acid in the vitamin C syrup.

2. Material and Methods

2.1 Materials

L-ascorbic acid, Sodium metabisulphite (antioxidant), Disodium EDTA (chelating agent), Methy paraben and propyl paraben (preservatives), Tartrazine (colourant), Orange Citrus (flavour), Citric Acid, 0.05M Iodine Solution, 0.1M Sodium thiosulphate, Starch Solution, sucrose, mixer, measuring cylinder, beakers, Analytical weighing balance. All these materials were taken from the raw-material store of Sewell Pharmaceutical Limited, Sango-Ota, Ogun State, Nigeria and were approved by the quality control manager prior to their usage.

2.2 Production of Vitamin C syrup

Vitamin C syrups with different overages of ascorbic acid were produced using pharmaceutical grade raw materials in the Chemistry Laboratory of Sewell Pharmaceutical Limited, Sango-Ota, Ogun State, Nigeria. Also, Vitamin C syrups with different percentages of sodium metabisulphite and EDTA were prepared in the same laboratory and stored in brown plastic bottles (120ml) at ambient temperature in the laboratory. The stability of ascorbic acid in the syrup was studied by taking samples from the reagent bottles at 7 days interval for 49 days.

2.3 Effect of Overage

The ascorbic acid content in the vitamin C syrup with an overage of ascorbic acid in different percentage of 10% (w/v), 25% (w/v) and 50% (w/v) was studied at ambient temperature for 49 days at 7 days interval.

2.4 Effect of Sodium metabisulphite.

The ascorbic acid content in the vitamin C syrup with different percentages (0.05% and 0.5% (w/v)) of sodium metabisulphite was also studied at ambient temperature for 49 days at 7 days interval.

2.5 Effect of Overage and Sodium metabisulphite.

The ascorbic acid content in the vitamin C syrup with an overage (10% w/v) of ascorbic acid and 0.05% and 0.5% (w/v) sodium metabisulphite was estimated at ambient temperature for 49 days at 7 days interval.

2.6 Effect of Overage, Sodium metabisulphite, and EDTA.

The ascorbic acid content in the vitamin C syrup with overage (10%) of ascorbic acid and 0.05% and 0.5% (w/v) sodium metabisulphite and 0.0025% (w/v) EDTA was estimated at ambient temperature for 35 days at 7 days interval.

2.7 Analytical Procedure

The ascorbic acid content of the vitamin C syrup in the experimental design above was assayed using titrimetric method with 0.05M Iodine solution (British Pharmacopoeia, 2009).

3. Result Analysis

3.1 Effect of Overage

The result of the effect of overages on the stability of ascorbic acid in the vitamin C syrup is shown in the Table 1. The four categories of syrup did not contain sodium metabisulphite (antioxidant) and disodium EDTA (chelating agent). The degradation of ascorbic acid in all these categories was rapid and fast which might be as a result of the absence of sodium metabisulphite and EDTA. It can be deduced from the Table 1 that the 10% (w/v), 25% (w/v) and 50% (w/v) overages did not contribute significantly to the stability of ascorbic acid when compared with the results of the stability of ascorbic acid in the syrup with no overage. For syrups with 10% (w/v), 25% (w/v) and 50% (w/v) overages, there were 24%, 26% and 25% degradations of ascorbic acid respectively between the first and last days of analysis of the syrup. The overall degradation of ascorbic acid in a syrup without an overage is also 26% which is similar to the overall degradation of ascorbic acid in the syrups with 10% (w/v), 25% (w/v) and 50% (w/v) overages. Therefore, it is obvious that the overage has no significant effect on the stability of ascorbic acid in vitamin C syrup.

Table 1. Effect of Overages on the Stability of Ascorbic Acid in the Vitamin C Syrup

Age (Days)	No Overage (%w/v)	10% Overage (%w/v)	25% Overage (%w/v)	50% Overage (%w/v)
0	99.02	108.60	120.00	148.25
7	93.37	106.64	117.00	145.25
14	88.18	104.34	115.00	140.35
21	81.27	102.01	113.00	134.00
28	79.69	86.95	98.66	118.72
35	75.40	85.80	93.10	113.73
42	73.01	83.79	91.41	112.57
49	72.47	81.59	87.66	111.10

3.2 The effect of Sodium metabisulphite

Table 2 shows the results of the effect of sodium metabisulphite alone on the stability of ascorbic acid in the vitamin C syrup. When the results on Table 2 are compared to the results on Table 1 of Vitamin C syrup without overage, sodium metabisulphite seems to prevent the oxidation reaction of ascorbic acid in the syrup. These results support the report of Vermeire et al (1999) that sodium metabisulphite prevents the oxidation reaction of many compounds, especially with phenolic groups. The Table 2 reveals that the ascorbic acid in the syrup of 0.5% (w/v) sodium metabisulphite is relatively more stable than the one in the syrup of 0.05% (w/v) sodium metabisulphite. There was no noticeable degradation of ascorbic acid in the syrup with 0.5% (w/v) sodium metabisulphite until 35 days whereas the degradation of ascorbic acid in the syrup with 0.05% (w/v) sodium metabisulphite became apparent after 14 days. Also, the percentages of the ascorbic acid degradation in the syrup with 0.05% w/v sodium metabisulphite and 0.5% w/v sodium metabisulphite between the first and last days of analysis are 23.94% and 4% respectively. Hence, it is evident from the Table that the higher percentage of sodium metabisulphite is more effective for the stability of ascorbic acid.

Table 2 Effect of Sodium Metabisulphite on the Stability of Ascorbic Acid in the Vitamin C Syrup

Age (Days)	0.05% Sodium Metabisulphite (%w/v)	0.5% Sodium Metabisulphite (%w/v)
0	99.28	99.49
7	99.28	99.49
14	95.96	99.49
21	91.64	99.49
28	81.93	99.49
35	77.89	99.03
42	77.81	98.18
49	75.51	95.48

3.3 Effect of Overage and Sodium metabisulphite

The results of the effect of overage and sodium metabisulphite on the stability of ascorbic acid are shown on the Table 3. The Table shows a pattern of stability of ascorbic acid that is similar to the results of stability of ascorbic acid on Table 2. This further shows different percentage of sodium metabisulphite enhances the stability of ascorbic acid in vitamin C syrup.

Table 3: Effect of Overage and Sodium metabisulphite

Age (Days)	10% Overage and 0.05%w/v Sodium metabisulphite (w/v%)	10w/v% Overage and 0.5w/v% Sodium metabisulphite (w/v%)
0	109.80	109.70
7	109.80	109.70
14	108.93	109.70
2	105.47	109.70
28	92.80	109.70
35	91.40	109.20
42	90.56	105.80
49	89.40	101.54

3.4 The effect of Overage, Sodium metabisulphite, and EDTA

Table 4 depicts the effect of overage, EDTA together with sodium metabisulphite on the stability of ascorbic acid in the vitamin C syrup. From the Table, it is evident that there was no noticeable degradation of ascorbic acid in the syrup with 10% Overage, 0.5% Sodium Metabisulphite & 0.0025% EDTA (%w/v). However, in the syrup containing 10% Overage, 0.05% Sodium Metabisulphite and 0.0025% EDTA (%w/v), there was 13% degradation of ascorbic acid between 21st day and 35th day. Comparing the results on Table 3 and Table 4, the ascorbic acid is more stable in the syrup with composition on Table 4 than the syrup with composition on Table 3. EDTA appeared to enhance the stability of ascorbic acid by chelating the heavy metals (Kari, 1995) that would have catalyzed the oxidation reaction of ascorbic acid. These results are in consonance with the reports of the previous investigation which found out that EDTA gives afflitiate effect with sodium metabisulphite for the prevention of oxidation reaction in drugs (Connors et al., 1986; Yeh et al., 1961)

Table 4. The effect of Overage, Sodium metabisulphite, and EDTA

Age (Days)	10% Overage, 0.05% Sodium Metabisulphite and 0.0025% EDTA (%w/v)	10% Overage, 0.5% Sodium Metabisulphite and 0.0025% EDTA (%w/v)
0	109.35	109.70
7	109.35	109.70
14	109.35	109.70
21	109.35	109.70
28	96.47	109.70
35	95.13	109.70

4 Conclusion

The results of this study have shown that overage did not contribute significantly to the stability of ascorbic acid in the vitamin C syrup. Although sodium metabisulphite enhances the stability of ascorbic acid, yet its antioxidant activity was not efficient until the addition of EDTA. Thus, EDTA has positive effect on the stability of ascorbic acid and the effects are more pronounced at the concentration of 0.5w/v% and 0.0025w/v% for sodium metabisulphite and EDTA, respectively in the vitamin C syrup.

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References

1. Alfred, II., Patrick, OO., Integrated Food Science and Technology for the Tropics. 1st Edition, 1985; 294-296.
2. Blasco, R., Esteve, MJ., Frigola, A.; Rodrigo, M. Ascorbic acid degradation kinetics in mushrooms in a high temperature short-time process controlled by a thermoresistometer. Lebensmittel - Wissenscharftund, technology, 2004; 37, 171-175.
3. Bristish Pharmacopoeia produced by the British Pharmacopoeia Commision Secretariat of the Medicine and Healthcare Products Regulatory Agency. 2009; 13 (1).
4. Connors, KA., Amidon, GL., Stella, VJ. Chemical stability of pharmaceuticals: a handbook for pharmacists, Wiley-Interscience, New York, 1986; 2nd Ed., 150 - 611.
5. Davey, MW., Van, M., Montagn, D., Inze, M., Sanmarton, A., Kanallis, A., Smirnoff, N. Chemistry Function Metabolism, Bioavailability and Effects of processing. Journal Science Food Agriculture, 2000; 80, 825 - 860.
6. David, LN., Michael, MC. Principles of Biochemistry. 2005, 4th Ed, 130-132.
7. Esteve, MJ., Frigola, A., Martorell, L., Rodrigo, MC. Kinetics of ascorbic acid degradation in green asparagus during heat processing. Journal of Food Protection, 1998; 61, 1518 -1521.
8. Foulke, JE., Maribeth, L. A fresh lo at food preservatives. FDA consumer. 1993; Available online@http//Vm.cfsan.fda.govt-dm/fdpresser.html.
9. Emese, J., Nagymate, PF. The stability of vitamin C in different beverages. British Food Journal. 2008; 110 (3), 296-309.
10. Kibbe, AH. Handbook of pharmaceutical excipients. Washington DC: American Pharmaceutical Association. 3rd Ed, 2000.
11. Martin, E. Principles of Human Nutrition. 1999; 2nd Ed., 185-188.
12. Marzena, P., Wanda, B., Anna, K., Barbara, K. and Aleksander, M. Determination of sodium metabisulphite in parenternal formulation by HPIC with suppressed conductivity detection. Acta Poloniae Pharmaceutical-Drug Research, 2011; 68 (5), 637-644.
13. Raymond, C. Chemistry. 2005; 8th Ed., 919.
14. Ronald, AB., Herbert, MC., James, PF., Sonja, K. , Robert LS. Chemistry of the Environment. 2005; 2nd Ed., 334-335.
15. Sharma, BK. Industrial Chemistry including chemical engineering, 2006; 15th Ed, 1518.
16. Stone, GB., Ames, J. Journal American Pharmaceutical Association, 1950; 39, 159.
17. Subrahmanyam, SV., Majeske, JP. Journal American Pharmeceutical Association, 1957; 129, 222.
18. Touitou, E., Gilhar, D., Alhaique, F., Memoli, A., Riccieri, FM. , Santucci, E. Ascorbic acid in aqueous solution; Bathochromic shift in dilution and degradation. International Journal of Pharmaceutical, 1992; 78, 85-87.
19. Vermeire, A., Remon, JP. Stability and compatibility of morphine. International Journal of Pharmaceuticals , 1999; 187, 17-51.
20. Warner, CR., Gregory, WD., Catherine, JN. Sulphites: An important food safety issue; Food testing and analysis, 2000; Available online @ http//www.cfsan.fda.govt-dm/fssulfite.html.
21. Yeh, SY., Lach, JL. Stability of morphine in aqueous solution. Kinetics of morphine degradation in aquoeus solution. International Journal of Pharmaceuticals, 1961; 50, 35 - 51.

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