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Full Length Research Paper

Haematinic potential of unripe mature pawpaw *(Carica candamarcensis)* fruit juice

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This study evaluated the micronutrient composition of unripe mature pawpaw *(Carica candamarcensis)* fruit juice in relation to management of anaemia in pregnant women and children (1 – 3 years). The pulp was grated and the juice extracted with Knowledge electric juice extractor. It was sieved with double folded muslin cloth to ensure its smoothness. The fresh undiluted juice was analysed for various nutrients using standard methods. The quantities of the juice required meeting the recommended nutrient intakes (RNI) for pregnant women and children (1–3 years) were calculated. Means and standard deviations were statistical tools employed. The results indicated that 100 ml of the juice contained folic acid (67 mcg), vitamin C (2.61 mg), vitamin E (0.94 mg), thiamine (0.061 mg), riboflavin (0.036 mg), niacin (0.80 mg), pyridoxine (0.021 mg), iron (0.97 mg), copper (0.06 mg), beta carotene (25RE) and zinc (0.05 mg). To meet their daily RNI for the various nutrients, pregnant women and children (1 – 3 years) require 9048 ml and 2381 ml of the juice each daily. The juice has haematinic potential to prevent and manage anaemia.

Key words: Anaemia, children, micronutrient composition, pregnant women, unripe mature pawpaw fruit juice, recommended nutrient intake.

INTRODUCTION

The high prevalence of malnutrition and febrile conditions, especially in children are core causes of major forms of anaemia in pregnant women and children under 3 years in developing countries. The result is diminution in the capacity of the blood (haemoglobin) to combine with and transport oxygen to all the tissues of the body (Waugh and Grant, 2006). Prevalence of anaemia is still high among pregnant women and children (Federal Ministry of Health, 2005) and its cause is frequently multi-factorial (Bothwell, 2000; Onimawo et al., 2010). Most diets consumed by pregnant women and their children are plant based. Nutritional anaemia in pregnant women and children occurs due to intake of foods with low iron bio-availability. In children, it often starts at a time the infant's iron stores are diminishing and breast milk no longer provides satisfactory supplies (Dewey, 2007; Lung'aho and Glahn, 2009). Inadequate absorption of dietary iron is the reason for the much higher prevalence of anaemia in developing countries (Ene-Obong, 2001; Agbon *et al.,* 2010). Anaemia has been associated with poor pregnancy outcomes such as intrauterine growth retardation and even death of the foetus (Fraser *et al.,* 2006), as well as poor growth and cognitive development in children (Yip, 2001). Many nutrients have been associated with anaemia (Taber and Kamal-Eldin, 2007; West et al., 2007; Zimmermann, 2007; Ricketts et al., 2006; Scott, 2007). Such nutrients include iron, zinc, copper, folic acid, vitamins C, E, A and $B_{12,}$ riboflavin, thiamine, and pyridoxine. Some of these nutrients are not directly involved in red blood cell production but like vitamin C, enhance the absorption and

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utilization of non heme iron when consumed together (Waugh and Grant, 2006). This implies that a diet rich in these nutrients can prevent anaemia and reduce its prevalence.

Fruits and vegetables are linked to the management of anaemia because they are rich in vitamins and minerals (Wardlaw and Hampl, 2007). One of such fruits is pawpaw. Pawpaw is a tropical plant whose fruit is green when young and yellow or orange when ripe. It is commonly grown in home gardens in Eastern Nigeria and therefore, readily available. Unripe mature pulp of pawpaw has 2.56 mg of iron, 0.056 mg of zinc and 0.001 mg of copper (Oloyede, 2005). The ripe specie contains 38.0 mg of folate, 0.10 mg of iron, 0.019 mg of pyridoxine and 61.8 mg of vitamin C (Ricketts et al., 2006), 15.8 mg of copper, 300 mg of beta carotene (Ene-Obong, 2001), 0.04 mg of thiamine, 0.40 mg of riboflavin, 70 mg of niacin and 136 mg of vitamin E (Pamplona-Roger, 2004).

Some women in the eastern part of Nigeria used unripe mature pawpaw fruit juice mixed with milk to treat anaemia. This is the basis of this study aimed at evaluating the micronutrient content of unripe mature pawpaw fruit juice in relation to its use in the management of anaemia.

MATERIALS AND METHODS

Source of the material

The unripe mature pawpaw fruit used for this study was harvested from a home garden. The maturity of the fruit was determined by the presence of a thin white membrane covering the black seed. This white membrane is lost during ripening. To ensure uniformity in the sample, all the fruits used for the analysis were got from the same pawpaw tree of the mountain pawpaw specie (*Carica candamarcensis*).Categorization of the sample specie was done at the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka.

Preparation of the sample

Three medium sized heads of unripe mature pawpaw fruit with mean weight of 0.89 kg were washed thoroughly in clean tap water and peeled with sharp kitchen knife. The peeled pawpaw fruits were sliced into four equal longitudinal parts to remove the seeds. The slices were grated into tiny particles with the finest part of clean kitchen grater. The juice was extracted from the grated pulp with Knowledge electric juice extractor and sieved with a double folded muslin cloth to ensure its smoothness. The undiluted samples were analysed immediately.

Chemical analysis

All the chemical analysis was carried out in triplicates. The nutrient contents were calculated in mg/100 ml. Ash was obtained by drying the sample at a temperature of 600^{o}C for 6 hours. Iron, zinc and copper were analysed from this ash by the method of Association of Analytical Chemists (AOAC, 1995). Vitamins C, E, riboflavin, thiamine, pyridoxine, folic acid and niacin were analysed by the method of AOAC (1995). Pearson's (1976) method was used in the analysis of beta carotene.

The percentage of the recommended nutrient intake (RNI) provided by the nutrients in the juice and the quantity of the juice required to meet the RNI were calculated.

a. Calculation of the percentage (%) of the RNI provided by the analysed nutrients was achieved using this formula.

$$\left(\frac{A}{RNI} \times \frac{100}{} \right) \%$$

Where A = value of the analysed nutrient in mg/100ml

b. Calculation of the quantity (ml) of the juice required to meet the RNI

$$\left(\frac{RNI}{A} \times \frac{100}{1} \right) \text{millilitres}$$

Where A = value of the analysed nutrient in mg/100 ml

c. The quantity to be consumed was compared with the average daily water requirement (40 ml per kilogram body weight) (Ene-Obong, 2001) to determine the adequacy of the fluid quantity to be consumed.

Statistical analysis

Means and standard deviations were calculated from 3 determinations.

RESULTS

Table 1 presents the micronutrient composition of unripe mature pawpaw fruit juice in mg per 100 ml of the juice.

Table 1. Micronutrient content of unripe mature pawpaw fruit juice.

Nutrients	Concentration (mg per 100ml of the juice)
Copper (mg)	0.06 ± 0.002
Zinc (mg)	0.05 ± 0.01
Iron (mg)	0.97 ± 0.02
Thiamin (mg)	0.06 ± 0.001
Niacin (mg)	0.80 ± 0.25
Folic acid (mcg)	67.00 ± 0.001
Vitamin E (mg)	0.94 ± 0.1
Vitamin C (mg)	2.61 ± 0.1
Riboflavin (mg)	0.04 ± 0.001
Pyridoxine (mg)	0.02 ± 0.0
Beta carotene (RE)	25.00 ± 2.41

Table 2. Percentage contribution of the nutrients to the recommended nutrient intakes of pregnant women and children (1 – 3 years).

	Pregnant women		Children aged 1 - 3 years	
Nutrients	***RNI**	**Percentage**	***RNI**	**Percentage**
Copper (mg)	1.0	5.6	0.34	16.5
Zinc	14.0	0.4	8.3	0.6
Iron (mg)	-------	-----	8.0	12.1
Thiamine (mg)	1.4	4.3	0.5	12.0
Folic acid	6 600.0	11.2	1 160.0	41.9
Vitamin E	10.0	9.4	6.5	14.5
Vitamin C	50.0	5.2	20.0	13.1
Riboflavin	1.4	2.6	0.5	7.2
Pyridoxine	1.9	1.1	0.5	4.2
Vitamin A (RE)	370.0	6.8	200.0	12.5

Sources of RNI (*Recommended Nutrient Intake) = FAO/WHO/UNU, 1985; FAO/WHO, 1988; FAO/WHO, 2004.

The juice contained copper (0.06 mg), zinc (0.05 mg) and iron (0.97 mg). The vitamin values were thiamine (0.06 mg), niacin (0.80 mg), folic acid (67 mcg), vitamin E (0.94 mg), vitamin C (2.61 mg), riboflavin (0.04 mg), pyridoxine (0.02 mg) and beta carotene (25RE).

Table 2 shows the percentage contribution of the nutrients to the recommended nutrient intakes (RNI) of pregnant women and children 1 – 3 years. Copper and zinc contributed 5.6 and 0.4% each to the RNI of pregnant women. For children aged 1 – 3 years, copper met 16.5% and zinc met 0.6% of their respective RNI. The juice made a percentage contribution of 12.1% of RNI for iron per 100ml for children aged 1 – 3 years. There was no available data on the RNI of pregnant women. The juice provided 12.0% of the RNI for thiamine for children (1 – 3 years) and 4.3% for pregnant women. For a pregnant woman, the juice provided 11.2% of folic acid RNI and vitamins E and C met 9.4 and 5.2% of their individual RNI for the same group. The juice provided 41.9, 14.5 and 13.1% of the RNI for folic acid, vitamin E and

Table 3. Quantity of the juice to be consumed to meet the daily RNI of pregnant women and children (1 – 3 years).

Nutrients	Pregnant women Millilitres	Children aged 1 - 3 years Millilitres
Copper (mg)	1786	607
Zinc	28000	16600
Iron (mg)	--------	825
Thiamine (mg)	2333	833
Folic acid	896	239
Vitamin E	1064	691
Vitamin C	1916	766
Riboflavin	3889	1388
Pyridoxine	9048	2381
Vitamin A (RE)	1480	800

vitamin C, respectively for children 1 – 3 years. Riboflavin made contributions of 7.2 and 2.6%, respectively to the RNI of children within the ages of 1 – 3 years and pregnant women. Vitamin B_6 (pyridoxine) value was equivalent to 4.2 and 1.1% of the RNI for children who were within the ages of 1 – 3 years and pregnant women, respectively. Vitamin A (beta carotene) value was equivalent to 12.5 and 6.8 % of the RNI for the 1 – 3 year old children and pregnant women, respectively.

Table 3 illustrates the quantity of the juice required to meet the RNI of pregnant women and children aged 1 – 3 years for the various nutrients. A pregnant woman needs to consume 1786, 28000, 2333 and 896ml to meet the daily RNI for copper, zinc, thiamine, and folic acid, respectively. She also requires 1064, 1916, 3889, 9048 and 1480 ml to meet the daily RNI for vitamins E and C, riboflavin, pyridoxine and vitamin A, respectively. A child aged 1 – 3 years require 607, 16600, 825, 833, 239 and 691ml to meet its daily RNI for copper, zinc, iron, thiamine, folic acid and vitamin E, respectively. To meet the RNI for vitamin C, riboflavin, pyridoxine and vitamin A, the child needs 766, 1388, 2381 and 800ml of the juice, respectively.

DISCUSSION

The value of vitamin C reported in this study was lower than the value reported by Ene-Obong (2001) on ripe pawpaw. The value of riboflavin was comparable with the report of Pamplona-Roger (2004). It has been reported that riboflavin may improve mobilization of iron from iron stores (Zimmermann, 2007). Iron and thiamine in the juice were higher than the values reported by other researchers on ripe pawpaw (Ene-Obong, 2001; Pamplona-Roger, 2004). Oloyede (2005) reported a higher iron value of 2.56 mg in unripe mature pawpaw pulp. This implies that the juice has the potential of improving iron status than the ripe specie. In addition, the vitamin C content of the juice is capable of enhancing the absorption of iron in the juice. Though, the folic acid is lower, vitamin C in the fruit juice can improve folic acid absorption (Ene-Obong, 2001). Severe thiamine deficiency is associated with megaloblastic anaemia. This is because it is associated with a specific type of megaloblastic anaemia which is responsive to thiamine alone (Rickets *et al.,* 2006). The values of pyridoxine and folic acid were lower than values in ripe pawpaw (Ene-Obong, 2001; Pamplona-Roger, 2004). Even the low pyridoxine can improve haemoglobin (Hb) synthesis (Ene-Obong, 2001) with more positive result on Hb level. Pyridoxin is an essential cofactor for aminolerulinic acid synthase – a rate limiting enzyme in haem biosynthesis (Scott, 2007).

Pamplona-Rogers (2004)] and Ene-Obong (2001) observed higher values of copper and vitamin E in ripe pawpaw than values in the unripe mature sample of the fruit juice. Oloyede (2005) observed a much lower value of copper (0.001 mg) than was reported in this study. Copper deficiency produces a functional iron deficiency anaemia that is responsive to copper and not to iron (Zimmermann, 2007). In vitamin E deficiency, anaemia occurs as a result of free radical damage to erythrocyte membranes (Taber and Kamal-Eldin, 2007). This makes the

red blood cell unable to reach their life span of 120 days. Ene-Obong (2001) also observed a higher value of beta carotene in ripe pawpaw (50RE) than the value in unripe mature fruit juice. This notwithstanding, the beta carotene in the juice could also contribute in elevating serum retinol and therefore helping to control anaemia induced by malnutrition or infection (Zimmermann, 2007).

The consumption of 2381 ml of the juice is required by a child who is aged 1 -3 years to meet the RNI for iron, folic acid, copper, vitamins A, C, E, thiamine, riboflavin and pyridoxine. This is on the assumption that the juice is the only source of these nutrients. This quantity provides almost 4 times the water requirement for a child of 3 years weighing 14.5 kg. Fluid requirement in febrile and diarrhoeal conditions is higher than the average daily intake of 40 ml per kg body weight. A pregnant woman requires 9048 ml of the juice daily to meet her RNI for same nutrients with the exception of iron. Though, the water requirement exceeded the average daily water requirement, no danger is anticipated if her kidneys are healthy and functional. The body has a mechanism for maintaining water balance and preventing accumulation of fluid in the body (Marieb and Hoehn, 2007). Consumption of foods that contain these nutrients would imply the consumption of lower quantity of the juice. The fruit juice consumed at meal time enhances both non heme iron and folate absorption (Ene-Obong, 2001) and improves the haematinic value of the juice. The juice is particularly beneficial to a convalescent. The sweetness of the juice would make it more tolerable to a sick person with loss of appetite than water. It would also serve as a refreshing drink on a hot dry day.

CONCLUSION

Unripe mature pawpaw fruit juice contains haematinic nutrients. The juice has potential to prevent and treat mild/moderate forms of anaemia.

RECOMMENDATION

The juice should be used as the only source of water during treatment. It should be consumed mostly at meal times. Pregnant women and young children should consume it as a prophylaxis since they are highly vulnerable to anaemia..

REFERENCES

Agbon CA, Okeke EC, Akinyemi CO (2010). Anaemia, nutrition status and parasitic infections among preschool children living in rural Nigerian villages. Nig. J. Nutr. Sci. 31,(2): 48 – 52.

Association of Analytical Chemists (1995). Official methods of analysis of the Association of Analytical Chemists. 14th edn. Washington DC: Association of Official Analytical Chemists.

Bothwell TH (2000). Iron requirement in pregnancy and strategies to meet them. Am. J. Clin. Nutr. 72: 257S – 264S.

Dewey KG (2007). Increasing iron intake of children through complementary foods. Food. Nutr. Bull. 28: 595S – 609S.

Ene-Obong HN (2001). Eating right: a nutrition guide. University of Calabar: Calabar Press, pp. 27, 29, 144.

FAO/WHO (1988). Requirements of vitamin A, iron, folate and vitamin B12: Report of a Joint FAO/WHO Expert Consultation, FAO Food and Nutrition Series No. 23. Rome: FAO.

FAO/WHO (2004). Human vitamin and mineral requirements: Report of a joint FAO/WHO. expert consultation, Bangkok, Thailand. 2nd edn. Rome: FAO.

FAO/WHO/UNU (1985). Energy and protein requirements. WHO Technical Report series No. 724. Geneva: WHO.

Federal Ministry of Health (2005). National guidelines on micronutrient deficiencies control in Nigeria. T. Oguntona, S.O. Omojekun, F.T. Aminu, K.O. Demehin & A.O. Falana. (Eds.). Abuja: Department of Community Development and Population Activities (Nutrition division), pp. 2 – 4.

Fraser DM, Cooper MA, Nolter-Anne GN (2006). Myles Textbook for midwives. African edn. Edinburgh: Churchill Livingstone, pp. 334 – 335.

Lung'aho MG, Glahn RP (2009). In vitro estimate of bio-availability of some Kenyan complementary foods. Food. Nutr. Bull. 30: 145 – 152.

Madukwe EU, Ugwuoke AL, Ezeugwu JO (2013). Effectiveness of dry Moringa oleifera leaf powder in the treatment of anaemia. Int. J. Med. Med. Sci. 5, (5): 226 – 228.

Marieb EN, Hoehn K (2007). Human anatomy and physiology. 7th edn. San Francisco: Pearson Benjamin Cummings, pp. 655, 1040 – 1041.

Oloyede OI (2005). Chemical profile of unripe pulp of Carica papaya. Pak. J. Nutr. 4, (6): 379–381.

Onimawo LA, Ukegbu PO, Asumugha VU, Anyika JU, Okudu H, Echendu CA, Nkwoala C, Emebu P (2010). Assessment of anaemia and iron status of school age children (aged 7 – 12 years) in rural communities of Abia State, Nigeria. Afric. J. Food Agric. Nutr. Dev. 10(5): 2570 – 2586.

Pamplona–Roger GD (2004). Healthy foods. Madrid:

Homles – Calleja Translations, pp.158.
Pearson D (1976). Laboratory techniques in food analysis. London: Butterworth and Co Ltd.
Ricketts CJ, Minton JA, Samuel J, Anyawansa L, Wales JK, Lo IF, Bar TG (2006). Thiamine responsive megaloblastic anaemia syndrome: long term follow up and mutation analysis of seven families. Acta. Paediatr. 95, (1): 99 – 104.
Scott JM (2007). Nutritional anaemia: B-vitamins. In K.Kraemer and M.B. Zimmermann (Eds.), Nutritional anaemia. Switzerland: Sight and Life Press, pp. 111 – 132.
Taber MG, Kamal-Eldin AK (2007). Oxidative stress and vitamin E in anaemia. In K.Kraemer and M.B. Zimmermann (Eds.), Nutritional anaemia. Switzerland: Sight and Life Press, pp. 155 – 187.
Wardlaw GM, Hampl, JS (2007). Perspective in Nutrition. 7thedn. New York: McGraw – Hill, pp. 325, 371, 419.
West KP, Gernand AO, Sommer A (2007). Vitamin A in nutritional anaemia. In K. Kraemer and M.B. Zimmermann (Eds.), Nutritional anaemia. Switzerland: Sight and Life Press, pp. 133 – 153.
Yip R (2001). Iron. In B.A. Bowman and R.M. Russell (Eds.), Present knowledge in nutrition. 8thedn. Washington DC: ILSI Press. pp. 311 – 328.
Zimmermann MB (2007). Interactions between iron and vitamin A, riboflavin, copper, and zinc in the aetiology of anaemia. In K. Kraemer and M.B. Zimmermann (Eds.), Nutritional anaemia. Switzerland: Sight and Life Press, pp. 199 – 213.