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Nutrient Content and Microbial Quality of Soymilk-Carrot Powder Blend

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Abstract: This study evaluates the nutrient content and microbial quality of soymilk fortified with carrot powder. Carrots, soybeans, sugar and flavourings were bought from local retailers in Ogige main market, Nsukka in Enugu State, Nigeria. The fresh carrots were washed, scrapped, trimmed, sliced, sundried, grinded, packaged and stored in a labeled polythene bag. The soybean seeds were sorted, cleaned, washed, soaked for 18 hours, drained and blanched for 25 minutes at 89°C. The blanched beans were pulverized with hot water; the paste formed was diluted with water at 1:5 and then sieved to get the soymilk. The soymilk was cooked for 23 minutes at 87°C. Flavor agents and sugar were added, 20g each of carrot powder was added to 500ml and 600ml of soymilk respectively. Microbial loads of the samples were also determined. It revealed that proximate composition, vitamin and mineral contents of the fortified soymilk (CS_2 and CS_3) were higher than the plain soymilk (CS_1). The total viable count of microbes of the samples CS_1 and fortified soymilk (CS_2 and CS_3) were $4.85\times10^{\circ}$CFU/mls, 6.25×10^1 CFU/mls and 6.80×10^1 CFU/mls, respectively. The result of the microbial counts revealed that the fortified soymilk (CS_2 and CS_3) contain higher microbial loads than the plain soymilk (CS_1). Nutrition educators should encourage the public to use carrot powder-soymilk blend because of its source of micronutrient. Further researches should be done on the best way of reducing contamination in carrot powder.

Key words: Chemical, microbial, quality, soymilk, carrot powder, fortified

INTRODUCTION

The basic cause of malnutrition (protein-energy malnutrition and micronutrient malnutrition) is poverty. The poor strata in developing countries such as Nigeria have a lack of purchasing power and spend a large percentage of their income on staple food. Animal products and fruits that are important sources of micronutrients are often more expensive and unaffordable; therefore it can be expected that multiple micronutrient deficiencies rather than singular deficiencies to be common in these settings (Richard and Martins, 2008). Although reduced energy intake remains a problem in many settings, suboptimal intakes of several micronutrients are more widespread and may be present even when energy needs are met.

Soymilk is an aqueous, white, creamy extract produced from soybeans which resembles cow milk both in appearance and consistency. It is a highly nutritious food drink which contains protein, fat, carbohydrates, vitamins and minerals. It is because of this nutritious value and comparative low cost (Wilson, 1995), that soymilk plays an important role in the dietary need of people in most developing countries.

Recently, the consumption of soymilk has greatly increased for reasons which include poverty alleviation and because it is recommended for people that cannot tolerate lactose since it does not contain lactose. It is continuously being used as a substitute to cow milk in most remote areas of Nigeria and indeed Africa. This may also be because it has a few other known advantages over cow milk e.g. it has a beneficial effect in the prevention of protein energy malnutrition in infants and growing young children as well as in the prevention of osteoporosis and kidney diseases (Messina, 1995). Carrots are rich in carotenes, some compounds that the liver transforms to vitamin A (Vincent, 2004). In recent years, the consumption of carrot and its related products has increased steadily due to the recognition of antioxidant and anticancer activities of b- carotene in carrot which is also a precursor of vitamin A (Mridula, 2011). Carrots are processed into products such as dehydrated carrots, juice, beverages, candy, preserves and halwa (Vincent, 2004).

The nutritious nature of soymilk however, makes it prone to microbial attack if not properly processed and stored as the nutrients it contains are also required for the growth of most spoilage organisms. A large number of microorganisms such as mesophilic aerobic bacteria, coliforms, yeasts and moulds are known to be responsible for the spoilage of soymilk, producing undesirable changes in the milk (Osuntongun and Aboaba, 2004). In Nigeria and most West African countries, soymilk is produced mostly at home under not very hygienic conditions and is thus prone to contamination and spoilage by the microflora of the raw materials and utensils. The metabolic products of these organisms as well as their presence in soy milk, pose health hazards to the consumers.

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The thrust of this study is to evaluate the nutrient content and microbial quality of soymilk-carrot powder blend.

MATERIALS AND METHODS

Sources of materials: Carrot, soybean, sugar and flavourings used were purchased from local retailers in Ogige main market, Nsukka in Enugu State, Nigeria.

Sample preparation

Production of carrot powder: Fresh carrots (2.4kg) were washed, scrapped and its end trimmed to remove dirts. It was grated using a grating machine and sun dried for three days (until crispy). The dried carrots were grinded into powder with a blender, packaged and stored in labeled polythene bag (Seagate, 2002).

Production of soymilk: Soybeans (500g) were sorted and cleaned to remove dirts and stones; washed twice to remove dust; and soaked for 18 hours. The soaked beans were drained and blanched for 25 minutes at 87°C, pulverized with hot water, the paste diluted with water (1:5) and sieved to get the soymilk. The soymilk was cooked for 23 minutes at 87°C, flavor agents and sugar were added and the milk was allowed to cool (Enwere, 1998). The plain milk was coded CS_1.

Method of fortification: Soymilk 500ml and 600ml were each fortified with 20 grams of carrot powder and were coded as CS_2 and CS_3, respectively. The fortified soymilk provided 1/3 350 Retinol Equivalent (RE) of Vitamin A requirement of an adult (1000RE) per day. It also provided a considerable amount of vitamin C, iron and zinc.

Chemical analysis: The moisture, ash, fat, protein and crude fibre content of the samples were determined using the method of AOAC (2005) methods. Carbohydrate content was obtained by difference. The AOAC (2005) standard methods were also used to determine iron (using phenanthroline method) and zinc (using dithizone method).

Beta carotene and vitamin C content of the samples were determined using the method of Pearson (1976).

Data analysis: The laboratory analysis was done in triplicates. The mean and standard deviation were calculated. The mean and standard error of mean was calculated. The analysis of variance using Duncan's new multiple range test was also used. Significance would be accepted at (P = 0.05). All these were done using SPSS (Statistical Packaged for Social Science) version 17.

RESULTS

The results in Table 1 presents the proximate composition of the plain soymilk and soy milk fortified with carrot powder. The moisture content of the samples varied from 86.76 to 89.84%. CS_1 had the highest moisture value (89.84%) while the CS_3 has the least value (86.76%). The protein values of the products ranged from 2.08 to 2.41% and the sample CS_3 had the highest value (2.41%). The fat content of the sample followed the same trend with that of protein. It ranged from 1.18 to 1.49%.The crude fibre content of the products varied from trace to 1.04%. The CS_2 and CS_3 had 1.04 and 0.84% crude fibre, respectively. The ash content ranged from 0.46 to 1.06% and the CS_2 had the highest ash value (1.06%). The trend of the carbohydrate content of the samples was similar to that of the ash value. The CS_2 had the highest value (7.31%) while CS_1 had the least value (6.44%).

The result in Table 2 presents the vitamin and mineral content of plain soymilk and soymilk fortified with carrot powder. Vitamin A contents of the products varied from 13.40 to 90.10RE/100g. CS_2 had the highest value followed by CS_3 while CS_1 had the least value (90.1, 78.4 and 13.4%, respectively). There were significant ($P<0.05$) differences in the vitamin A content of the products. Vitamin C of the products ranged from 8.07-9.82mg/100g. The sample CS_2 had the highest value (9.82mg/100g) while CS_1 has the least value (8.07mg/100g). There were differences in the vitamin C values of the products; however, it was not significant (P = 0.05). The iron content of the products varied from 1.44 to 1.86 mg/100g. CS_2 had the highest value followed by CS_3, while CS_1 had the least value (1.86, 1.78 and 1.44 mg/100g, respectively). The zinc content

Table 1: Proximate composition of different soymilk beverages in percentages (%)

Samples	Moisture	Protein	Fat	Crude fibre	Ash	Carbohydrate
CS_1	89.84	2.08	1.18	Trace	0.46	6.44
CS_2	86.76	2.38	1.45	1.04	1.06	7.31
CS_3	87.53	2.41	1.49	0.84	0.99	6.74

Key: CS_1= Plain soymilk, CS_2= 500mls of soymilk fortified with 20g carrot powder, CS_3= 600mls of soymilk fortified with 20g carrot powder

Table 2: Vitamin and mineral content of the samples

	Beta-carotene (RE)/100g	Vitamin C (mg)/100g	Iron (mg)/100g	Zinc (mg)/100g
CS_1	13.40 ± 0.10^a	8.70 ± 0.10^a	1.44 ± 0.07^b	35.77 ± 0.07^c
CS_2	90.10 ± 0.21^c	9.82 ± 0.10^a	1.86 ± 0.07^b	39.13 ± 0.12^c
CS_3	78.40 ± 1.30^b	9.53 ± 0.00^a	1.78 ± 0.00^b	38.33 ± 0.35^c

Key: CS_1= Plain soymilk, CS_2= 500mls of soymilk fortified with 20g carrot powder, CS_3= 600mls of soymilk fortified with 20g carrot powder.
Note: Mean ± SD with different superscripts are significantly different with $a<b<c$ ($P<0.05$)

Table 3: Microbial count of the samples

	TVC (ml)	Coliform (ml)	Mould (ml)
CS_1	4.85×10^0	1.70×10^0	9.50×10^0
CS_2	6.25×10^1	1.46×10^1	4.50×10^2
CS_3	6.80×10^1	1.50×10^1	6.20×10^1

Key: CS_1 = Plain soymilk, CS_2 = 500mls of soymilk fortified with 20g carrot powder, CS_3 = 600mls of soymilk fortified with 20g carrot powder

differs from 35.77 to 39.13 mg/100g. It follows the same trend with that of iron values and the differences between the products was not significant (P = 0.05).

Table 3 presents the microbial count of plain soymilk and fortified soymilk. The total viable count differed. The values ranged from 4.85×10^0 to 6.80×10^1. CS_3 contains the highest number of viable organisms followed by CS_2, while CS_1 had the least value (6.80×10^1, 6.25×10^1 and 4.85×10^0, respectively). The coli form counts of the soymilk beverages were different. The values ranged from 1.70×10^0 to 1.50×10^1. CS_3 had the highest number of coliform forming unit followed by CS_2, while CS_1 had the least value (9.50×10^0, 1.46×10^1 and 1.70×10^0, respectively). The mould count of the soymilk beverages differed. The values ranged from 9.50×10^0 to 4.50×10^2. CS_2 had the highest number of mould count followed by CS_3, while CS_1 had the least value (4.50×10^2, 6.20×10^1 and 9.50×10^0, respectively)

DISCUSSION

Proximate composition: The higher moisture content of CS_1 (89.84%) suggests that the product is more diluted than the soymilk fortified with carrot powder. The value corresponds with Enwere (1998) that about 92.75% of soymilk is water. The protein content of the soymilk blends were increased as a result of the added carrot powder. CS_3 has more protein content compared with the other products. This result confirms published work that observed that when nutrients from different foods are blended, the nutrients so produced would be better than any of the food alone (Egbekun *et al.*, 2004). The fat content of the control soymilk (CS_1) (1.18%) was lower than that of the soymilk blends-CS_2 (1.45%) and CS_3 (1.49%). This is as result of the synergistic effect of the soymilk and carrot powder. This is in line with the work done by WISSH (2006) that the fat content of plain soymilk is (1.02%) and that it may vary depending on the ingredient added. The crude fibre of CS_2 (1.04%) and CS_3 (0.84%) were significantly increased, while that of CS_1 is trace. This agrees with the work done by Enwere (1998) that soymilk contains no crude fibre. The presence of crude fibre in CS_2 and CS_3 suggests that carrot powder had significant amount of crude fibre (Vincent, 2004). The fortified soymilk had higher ash content than the unfortified soymilk. This might be as a result of higher mineral content of the carrot powder (Vincent, 2004). The carbohydrate content of the fortified soymilk blends had higher carbohydrate content than that of the unfortified soymilk. The higher value for CS_1 (6.44%) corresponds with the work published by (Vincent, 2004), that soymilk contains 6.3% carbohydrate.

Vitamin and mineral content: The higher beta-carotene content of CS_2 (90.1RE) followed by CS_3 (78.4RE) suggest that they were fairly good sources of the nutrient. However, the lower value for CS_1 (13.4RE) is an indicative of its poor source of the nutrient. The higher micronutrients levels of CS_2 and CS_3 suggests that they are better sources of beta-carotene, ascorbate, iron and zinc than CS_1. On the other hand, the lower values of the micronutrients for CS_1, suggests that plain soymilk is not a good source of the micronutrient as compared with CS_2 and CS_3. These increases in the micronutrients might be attributed to synergistic effect of carrot to soymilk. This result confirms published work that observed that when nutrients from different foods are blended, the nutrients so produced would be better than any other foods alone.

Microbial count: The greatest problem encountered with spoilage organisms in the milk, where they multiply and cause unwanted effects. The significance difference in Total viable counts of CS_3 is indicative that the product would prone to deterioration as seen in Table 3. It is known that the higher the concentration of pathogenic micro-flora, the higher chances of spoilage of the products (Brooks and Asamudo, 2003). The higher concentration of coliform in the same product (CS_3) is a further confirmation that it has a lower keeping quality as compared with the other two products. The higher level of mould in CS_2 is also indicative that its wholesomeness is questionable. On the other hand, the lower concentrations of pathogenic microflora content in CS_1 suggest its wholesomeness and should be recommended for public consumption. Molds are problematic in foods in that they discolour food surfaces, cause off odours and off flavours as well as produce toxins in certain instances (Momoh, Udobi and Orukotan, 2011). Microorgranisms which are known spoilage agents of soymilk can be controlled using a combination of pasteurization, preservative and refrigeration (Momoh *et al.*, 2011).

Conclusion: This study showed that the nutritive values of all the fortified soymilk were improved both in quality. The proximate composition, mineral and vitamin content of the fortified soymilk were higher than the plain soymilk. The result of the microbial count revealed that the fortified soymilks (CS_2 and CS_3) contain higher microbial loads than the plain soy milk.

Recommendation: Nutrition educators should encourage the public to use carrot powder-soymilk blend because it is a source of micronutrient.

Another method of drying should be used to get carrot powder in order to reduce contamination

Carrot powder should be used to fortify other food products. It could be used to fortify infant foods e.g., pap

Carrot powder could be used as one of the potentially locally available foods to treat micronutrient deficiency especially vitamin A deficiency in the community.

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