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The chemical composition of ''Multimistura'' as a food supplement

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Abstract

The utilization of a ''Multimistura'' as a food supplement, in nutritional improvement programmes for low-income populations, represents a low cost, fast food preparation alternative which satisfies local taste preferences. This is based on the fact that the ''Multimistura'' is made up of non-conventional ingredients/foods and/or agroindustrial by- products rich in different nutrients. The present work has been designed to analyse the chemical composition of a ''Multimistura'' utilized as food supplement in institutional programmes to prevent malnutrition by means of the Department of Wealth and Social Affairs of the City of Natal-RN, Brazil. The product studied was elaborated by employing the following formulation: wheat bran 30%, wheat flour 30%, corn bran 30%, powder from cassava leaves 3%, pumpkinseeds powder 4% and egg shell powder 3%. The results from the chemical analysis made, showed that the product presented high levels of carbohydrates (67.0%) and proteins (12.7%), the total caloric value (TCV) corresponding to 377 kcal/100 g. The amino acids profile was deficient in only two essential amino acids, methionine and phenylalanine, when compared to a standard protein from FAO/WHO, which resulted from the biological nature of the product. The analysis of micronutrient minerals revealed the products as being a potential source of calcium, as well as a good source of phosphorus, magnesium, iron and zinc. The ''Multimistura'' presented a significant content of carotene, which favours the roll of vitamin A, although thiamine, riboflavin and niacin were detected.

1. Introduction

Studies carried out in different regions of Brazil have indicated a high incidence of malnutrition, mainly in children under 5 years of age (UNICEF, 1994). To combat the problem of malnutrition in Brazil, many alternative interventions have been put into practice. They vary from the traditional programs of food supplementation carried out by different government Departments of Wealth and Social Affairs, to the use of simple alternatives of very low cost, such as use of non-conventional products or of alternative foods. Since 1986, the Alternative Nutrition in Brazil has been incorporated to the routine work of governmental and non governmental institutions, such as the National Health Foundation (Fundação Nacional de Saúde), Children's Affairs (Pastoral da Criança—CNBB) and has reduced the national malnutrition (UNICEF).

As the general principle of alternative nutrition is based on the use and re-utilization of non-conventional foods, many different ways of preparing the alternative foods have been developed. Among them the ''Multimistura'' was developed, in 1988, by Brandao and Brandao, and has been used as a food supplement for pregnant women and children, in the combat against malnutrition. It has been formulated from by-products such as wheat and rice meal, powder from cassava, sweet potatoes and beldroega leaves, powder from pumpkin, water melon, melon, sesame seeds and egg shell powder (Brandao, 1989). The use of such by-products in the formulation of the ''Multimistura'' has been based on two main points: (1) these ingredients are good sources of proteins, vitamins and minerals; and (2) they represent a very low cost. However, their utilization as a nutritional alternative source has been contested, since there is no information available about their chemical composition, along with the fact that some ingredients are sources of toxic and anti-nutritional substances, such as cyanide acid, phytates and tannin.

This study was conducted in order to determine the nutrients in an alternative food, ''Multimistura'', utilized

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in institutional food supplementation programmes to combat and prevent malnutrition.

2. Material and methods

The product sample analysed was a food supplement, named "Multimistura", which is used in the governmental programs, in the Northeast of Brazil (Natal-RN), to prevent and combat malnutrition in children from 6 months to 5 years of age. Three samples were collected from local production "ATIVA" (Social Activity Association) in distinct periods in 1995 (January, May and September). Approximately 1 kg of each sample was obtained from ten sub-samples (around 100 g), which had been acquired from different parts of the whole production. After collection, sub-samples were mixed, packed into 1 kg polypropylene bags and transported to the laboratory.

The "Multimistura" was formulated with the following ingredients: wheat bran 30%, wheat flour 30%, corn bran 30%, cassava leaves powder 3%, pumpkin seeds powder 4% and egg shell powder 3%, and prepared according to the ATIVA process (Câmara, 1996). Since the ingredients were in the form of powder, the preparation process consisted basically of weighing and mixing the ingredients. However, before formulation the ingredients were submitted to drying, roasting, blending, grinding and sieving.

Cassava leaves were selected, washed and dried in the shade at ambient temperature (32°C) for 5 days. Next, the dried leaves were ground three consecutive times in a mill using a 0.8 mm mesh size, until a powder was obtained, then it was sieved and packed into plastic bags.

Pumpkin seeds initially were washed in tap water to remove impurities, sand, and pieces of fruit. Then they were dried in the sun at a temperature of 38°C for 72 h. After the seeds had been cleaned and dried, they were selected and roasted in an aluminium pan by mixing with a wooden spoon, on a domestic stove. The roasted seeds were ground, sieved and conditioned in plastic bags.

Egg shells were submerged (broken) in a bowl containing tap water so the residues were primarily eliminated. Subsequently, the shells were submerged in a 1% chlorine solution for 10 min, for disinfection. Following disinfection, they were washed in tap water and the internal skin was removed. The shells were dried in the sun for 24 h, ground and sieved in a cotton cloth to obtain a fine powder, and then packed into plastic bags.

Wheat bran broken grains were eliminated from the wheat bran by using a straw sieve. The bran was roasted for 20 min in a large aluminium pan by mixing it continuously, cooled and packed into plastic bags.

Wheat flour (classified as Group 1; Kent, 1983) and corn bran were roasted separately in large aluminium pans for 20 min, cooled and packed into plastic bags.

2.1. Chemical composition

Dry matter was determined by drying at 100°C to constant weight (AOAC, 1984; AOAC 14.003). *Ash* was gravimetrically obtained after combustion of dried sample in a furnace at 500–550°C (AOAC, 1984; AOAC 14.006). *Fat* was extracted with petroleum ether using the Soxhlet method (AOAC, 1984; AOAC 7.062). *Total nitrogen* was determined using the Kjeldahl method by digestion of the sample in a Sarge digestion system, followed by a nitrogen distillation (Tecnal model TE-036/1), crude protein was calculated by multiplying Kjeldahl nitrogen by 5.7 (AOAC, 1984; AOAC 2.055). *Carbohydrates* were determined by the Lane–Eynon general volumetric method in order to quantify glucose and sucrose (AOAC, 1984; AOAC 31.036). The same method was used to determine the starch content, after the material has been submitted to an acid hydrolysis. *Crude fibre* was determined by using an acid and alkaline digestion (Pregnolatto & Pregnolatto, 1985, p. 54). The *caloric value* was determined by calculation, using the factors 9.0 for lipids and 4.0 for carbohydrates and proteins. All analyses were performed in triplicate, for each of the three samples of "Multimistura" and its ingredients; means and standard errors of means for each component were obtained. The variations among the means were examined using a two-way analysis of variance (ANOVA) and tested by Least Significant Difference (LSD) for $p = 0.05$ to compare any two means.

2.2. Amino acid analysis

Two batches of each "Multimistura" and each pumpkinseed powder sample were analysed. The *amino acid composition* of each specimen was determined in an amino acid analyser (Dionex, mod DX). After the acid hydrolysis (6.0N HCl) for 22 h, the amino acids were separated on a single cation-exchange resin column, followed by reaction with ninhydrin reagent. A sample of Pierce standard aminoacids, in duplicate, served as the reference for protein control.

2.3. Minerals

The mineral fractions in the "Multimistura" and in some ingredients (wheat bran, cassava leaves powder and eggshell powder) were quantified. Three portions (approximately 5.0 g) of each of the three samples of "Multimistura", wheat bran, cassava leaves powder and egg shell powder, were weighed and the organic materials were destroyed in a furnace at 500°C, then residues were dissolved in 50 ml of 2.5% HNO_3 solution. The

Table 1
Proximate composition per 100 g dry "Multimistura" and its constituents[a]

Component	Samples						
	Multimistura	Wheat bran	Wheat flour	Corn bran	Cassava leaves powder	Pumpkin seeds powder	Egg shell powder
Dry matter (g) (fresh wt)	92.83 ± 0.14b[b]	92.78 ± 0.04b	92.63 ± 0.15b	91.74 ± 0.06bd	90.74 ± 0.20d	96.80 ± 0.05c	98.77 ± 0.0
Ash (g)	5.22 ± 0.22ac	5.02 ± 0.62ac	0.56 ± 0.08b	0.23 ± 0.01b	6.71 ± 0.30c	4.23 ± 0.04a	93.4 ± 1.97
Fat (g)	3.93 ± 0.06d	5.35 ± 0.01d	1.48 ± 0.07ab	1.94 ± 0.49a	6.84 ± 0.13c	39.7 ± 0.07e	0.76 ± 0.07
Protein (g)	13.6 ± 0.11bd	18.0 ± 0.2b	14.0 ± 0.5d	8.84 ± 0.31d	30.4 ± 0.32c	35.4 ± 0.3c	4.22 ± 0.88
Crude fiber (g)	4.89 ± 0.50b	9.36 ± 0.38a	0.87b tc0.03c	5.56 ± 0.13b	11.14 ± 0.47a	10.74 ± 0.4a	–
Carbohydrate (g)	71.8 ± 0.20a	61.80 ± 0.6ad	83.9 ± 0.5ab	83.7 ± 0.4ab	44.0 ± 0.47d	9.74 ± 0.13c	–

[a] Means ± SE. Number of composite samples is three with three replicate each DM, ash, fat, protein, crude fiber and carbohydrate.
[b] Means for each row with different letters are different at $p < 0.05$.

concentrations of Ca, Mg, Fe, P, K, Zn in the sample solutions were determined by spectroscopy emission, based upon plasma, in a ICP-AES spectrometer (Baird, mod ICP 2000), according to the method described by Angelucci and Mantovani (1986). The samples were quantified, based on standard solutions (certificate) of known concentration analysed concurrently.

2.4. Vitamins

The vitamin contents were determined in three samples of "Multimistura" and in three others of cassava leaves powder. Analyses of carotene, thiamine (B1), riboflavin (B2) and niacin were performed, in triplicate, by HPLC following the methods described by Carvalho, Collins and Rodriguez-Amaya (1992) for carotene, Strhecher and Henning (1967) and van de Weerdhof, Wiersun and Reissenwber (1973) for thiamine and riboflavin and Lan, Holocomb and Fusari (1984) for niacin.

3. Results and discussion

The chemical composition analyses showed that the "Multimistura" is a product rich in carbohydrates (71.8%) and proteins (13.6%), with 3.93% of lipids (Table 1). The high concentrations of carbohydrates and protein gave a caloric value of 377 kcal/100 g. Starch was the main compound in the carbohydrate group (68.5%); glucose and sucrose amounts were only 0.88 and 1.94%, respectively. The high concentration of carbohydrate resulted probably from wheat bran, wheat flour and corn bran which are ingredients rich in starch. Although the pumpkinseed and cassava leaf powders presented high concentrations of proteins, it was mainly the flour and brans that provided the total content of proteins in the "Multimistura". Figueiredo and Rego (1973) reported that protein, vitamin and mineral contents were higher in the cassava leaves compared to root.

The egg shell powder was extremely rich in minerals, which supplied most of the ash content found in the "Multimistura" (4.87%). Mertz (1984) reported that eggshells were formed basically of calcium carbonate, with approximately 2.0 g. The ash concentrations found in pumpkinseed powder were very similar to those found in wheat bran and cassava leaves powder.

Unfortunately there is no paper in the literature reporting chemical composition of any similar products. However, the present work indicated that the chemical composition of its constituents was in general agreement with values shown in the literature (Albuquerque, 1992; Bartinik, 1989; Salgado & Takashima, 1992).

The amino acid composition of "Multimistura" and pumpkinseeds powder showed that seventeen amino acids were detected among the 22 amino acids found in nature (Table 2). Glutamic acid was present in the highest concentrations, while cistine and methionine were lowest in both samples. Comparing the amino acid

Table 2
Amino acid content of "Multimistura" and pumpkin seeds powder

Component	"Multimustura" (mg/100 g)	Pumpkin seeds powder (mg/100 g)
Alanine	5.26 (0.23)	4.36 (0.36)
Arginine	3.97 (0.86)	8.62 (1.01)
Aspartic acid	7.97 (0.41)	11.6 (1.29)
Cistine	1.53 (0.05)	0.95 (0.09)
Glutamic acid	25.7 (1.12)	20.3 (1.57)
Glycine	5.36 (0.36)	8.94 (0.61)
Histidine	5.22 (0.39)	3.94 (0.28)
Isoleucine	3.53 (0.17)	3.27 (0.36)
Leucine	8.25 (0.28)	6.69 (0.70)
Lysine	5.49 (1.18)	5.45 (0.92)
Methionine	1.25 (0.09)	1.41 (0.12)
Phenylalanine	5.24 (0.36)	4.99 (0.92)
Proline	8.62 (1.33)	3.22 (0.19)
Serine	5.35 (0.66)	5.71 (0.33)
Treonine	3.59 (0.99)	2.79 (0.40)
Tryptophan	–	–
Tyrosine	3.27 (0.37)	5.38 (0.76)
Valine	4.77 (0.23)	4.14 (0.41)

Table 3
Minerals of "Multimistura" and some of its constituents[a]

Minerals	"Multimistura" (mg/100 g dry wt)	Wheat bran (mg/100 g dry wt)	Cassava leaves powder (mg/100 g dry wt)	Egg shell powder (g/100 g dry wt)
Ca	1,419 ± 1.22a[b]	90.31 ± 0.78b	905 ± 8.25c	37.6 ± 0.12d
K	532 ± 0.15c	1,018 ± 4.60a	1,687 ± 11.35b	–
P	509 ± 1.60b	1,1134 ± 15.4a	302 ± 2.36c	–
Mg	190 ± 0.12a	396 ± 1.30b	343 ± 4.46b	–
Na	7.91 ± 0.57a	–	33.3 ± 2.32b	–
Fe	4.79 ± 0.10a	13.04 ± 0.08c	11.9 ± 0.71c	–
Zn	3.29 ± 0.03a	8.32 ± 0.04b	3.00 ± 0.01a	–

[a] Means ± SE for three composite samples with three replicates each.
[b] Means for each row with different letters are different at $p < 0.05$.

composition of the "Multimistura" with the reference standard of FAO/OMS (1973), the methionine was the first limiting amino acid, while phenylalanine was the second. Lazos (1986) also reported methionine as the first limiting amino acid in defatted pumpkinseed flour, while Salgado and Takashima (1992) reported lysine as the first limiting amino acid in a similar flour.

The "Multimistura" proved to be an excellent source of calcium and a good source of other micronutrients such as K, P and Mg, with reasonable amounts of Na, Fe and Zn (Table 3). Among the minerals analysed, Zn content was the lowest. Considering the daily proportion used by ATIVA (33 g) and the daily intake needs (NRC/RDA, 1989) for children, aged 1 to 6 years, the "Multimistura" can contribute with as much as 73% of Mg daily needs and 54% of Ca, 20% of P, 15% of Fe and 10% of Zn of the mineral requirements. Calcium, potassium and phosphorus were, respectively, the main components in the ash fraction of the egg shell powder, cassava leaves powder and wheat bran. High amounts of Mg were also found in cassava leaves powder and wheat bran. The mineral of egg shell generally has calcium as the main element (Mertz, 1984). Although the "Multimistura" has distinct amounts of micro minerals, research should be carried out involving aspects of the biodisposibility of these minerals. The calcium–zinc interaction during the digestion process, has been reported in a controversial manner by Song et al. (1985) and Avancini (1988).

Some vitamins were also found in the "Multimistura", i.e. carotene, thiamine (B1), riboflavin (B2) and niacin. The niacin concentration was 10.9 mg/100 g, while the thiamine and riboflavin were, respectively, 0.33 and 0.05 mg/100 g. Carotene content was 227 mg/100 g.

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