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Effect of Soybean Flour Supplementation and Cooking on Amino Acids Composition of Corn Flour

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Abstract

The objective of this study is to evaluate the effect of supplementation by different levels of defatted soya bean cake and cooking on amino acids composition of corn flour. The effect of supplementation with 3, 5 and 7% of soybean cake and cooking on amino acids composition of corn flour was investigated. Supplementation with 3,5and 7% Soya bean flour insignificantly (P≤0.05) increased the protein content in most of the amino acids and amino acid scores. Amino acids contents of composite flours were decreased after cooking except (Histidine, Aspartic acid, cysteine, Glutamic acid and Arginine).

Keywords : Supplementation, Corn flour, Soy bean, Amino acids, cooking

Introduction

Cereals are the most widely cultivated and consumed crops on globally. In Nigeria, specifically in the Northern part of the country, cereal provides a major food resource for man. It is the major source of energy and protein in the diet of many people. Maize is the second most important cereal crop in Nigeria ranking behind sorghum in the number of people it feeds. Maize is a multipurpose crop, providing food and fuel for human being and feed for animals (poultry and livestock). Its grain has great nutritional value and can be used as raw material for manufacturing many industrial products. (Afzal et al., 2009).

In most countries, lime-treated corn provides 31% of the total protein and 45% of the energy intake, and beans 24% of the protein and 12% of the calories. Such diet is low in protein quality and quantity, as well as in energy (US National Library of Medicine Institutes of Health 2003).

To overcome these deficiencies, corn can be supplemented either with its limiting amino acids, lysine and tryptophan, or better still, with whole soybeans which improve not only the amount and quality of the protein consumed but, because of their high oil content, the energy intake as well.

The soybean (Glycine max) is one of the most important food plants of the world, and seems to be growing in importance. It is an annual crop, fairly easy to grow, that produces more protein and oil per unit of land than almost any other crop. It is a versatile food plant that, used in its various forms, is capable of supplying most nutrients. It can substitute for meat and to some extent for milk. The soybean (Glycine max) is the seed of the leguminous soybean plant. It has high protein content and is not very expensive. Therefore, it has been proposed as an ideal source for protein supplementation of starchy foods. It is a crop capable of reducing protein malnutrition. In addition, soybeans are a source of high value animal feed. Higher levels of soybean products, however, may affect the consistency of the lime-treated corn dough and, therefore, the tortilla acceptability.

At a level of 15 parts of whole soybean or 8 parts soybean-derived products, to 85--92 parts of corn there were no significant changes in the rheological or organoleptic characteristics of the tortilla prepared thereof. (US National Library of Medicine Institutes of Health 2003). Since corn is usually cooked, but not ground, at home, the soybean supplement can be successfully added at the wet--milling stage of dough preparation or whole soybeans and corn may be cooked together, when a nutritional

intervention is desired at the village level. (US National Library of Medicine Institutes of Health 2003). At an industrial scale, if whole soybeans are used, they may be cooked together with corn, and if soy flour is used, this can be mixed at the end of the process when the cooked corn is ground to flour. (US National Library of Medicine Institutes of Health 2003).

Material and Methods

A Grain of corn was obtained from the department of agronomy, faculty of agriculture, university of Khartoum, Shambat, Sudan. The grains were cleaned, freed from foreign seeds, broken and shrunken ones, then was milled into fine flour using house blender and mortar to pass through 0.4mm screen and stored in polyethylene bags at 4°C for further analysis. Soybean seeds were brought from Omdurman local market. The seeds were defatted using hexane solvent and dried in a hot air oven at 70° C for 3-4 hours, then milled in to fine flour using house blender and mortar to pass through 0.4mm and stored in polyethylene bags at 4° C for further use. All chemicals used in this study were being of reagent grade. Defatted soybean seeds flour was added using Pearson square nutritive value of corn flour by 3, 5 and 7%, respectively. Cooking of the sample was performed by suspending the flour of each samples in distilled water in the ratio of 1:2 (flour: water, w/v) and the slurry will be shaken to avoid lumps while boiling in a water bath for 20 min. The viscous mass was spread out thinly in dishes and oven dried at 70°C. The dried flakes were milled into fine flour by house blender and mortar to pass through 0.4mm screen and stored at4°C for further analysis. The analysis of free amino-acids has been demonstrated using the Pico-tag methods after deproteinization and precipitation with 5-sulfosalicylic acid (SSA) followed with centrifugation to remove the precipitation protein .the supernatants were taken for free amino analysis, the amino acids com position of experimental samples were determined using HPLC-Pico-tag method according to Millipore Cooperative (1987).the Pico-Tag method; was described by Herinrikson, R. L and Meredith, S. C (1984). The Pico-Tag method was developed commercially by waters associates. Was an integrated technique for amino-acid analysis, Phenylisothiocyanate (PITC-or Edman's reagent) was used for pre-column derivatization, while reversed-phase gradient elution high-performance liquid chromatography (HPLC) separates the phenylthiocarbamy (PTC) derivatives which detected by their UV absorbance. The chromatographic analysis using HPLC was carried out using the following gradient on Pico-Tag solvent A and B(P/N88108 and 88112) sample was injected and loaded on Pico-Tag amino acids column(150 ×3.9 mm) stainless steel. Detection of the PTC derivatives is by ultraviolet absorption measurements using a fixed wavelength (254nm) waters detector. Before injecting of the sample. The illustrated was calibrated by two injections of the standards (Cohen et al., 1989). All data were subjected to statistical analysis, each determination was carried out and analysed in triplicate and figures were then averaged. Data was assessed by the analysis of Variance (ANOVA) (Gomez & Gomez, 1984). Duncan Multiple Range Test (DMRT) was used to separate means. Significance was accepted with at $P \leq 0.05$.

Results and Discussion

The Amino acids contents of Corn flour and their Supplements (3, 5 and 7%) Soya bean protein was shown in Table. 1.Aspartic acid, Glutamic acid, Serine, Glycine, Histidine, Arginine, Threonine, Alanine, Proline, Tyrosine, Valine, Methionine, Cysteine, Isoleucine, Leucine, Phenylalanine and Lysine were detected of Soya bean flour protein and supplemented with 3, 5 and 7% Corn flour . Glutamic acid content of Corn flour was found to be 0.92mg/100g, it was increased after supplementation with 3, 5and 7% Soya bean flour protein to 12.08, 15.91and 17.31mg/100g, respectively. Aspartic acid content of Corn flour was found to be 1.19mg/100g, it was increased after supplementation with 3, 5and 7% Soya bean flour protein to 3.57, 4.78and 7.21 mg/100g, respectively.

Table 1: Effect of supplementation with Soya bean flour on Amino acids composition (mg/100g) of Corn flour.

Amino acids	Corn flour (raw)	Soya bean flour(raw)	Un cooked mixed flour levels (%)		
Essential Amino acids			3%	5%	7%
Histidine	0.32	4.49	17.43	3.97	3.49
Isoleucine	3.70	29.25	0.22	3.15	8.83
Leucine	3.75	19.54	0.15	2.14	5.99
Lysine	4.12	16.49	0.20	2.58	4.97
Methionine	3.97	40.77	1.58	0.57	0.61
Phenylalanine	4.66	6.5	0.79	10.27	1.98
Threonine	3.90	4.46	0.63	0.93	1.98
Valine	3.12	2.43	0.68	4.00	1.81
Non-essential Amino acids					
Aspartic acid	1.19	36.34	3.57	4.78	7.21
Cysteine	1.06	28.94	0.53	3.11	8.71
Glutamic acid	0.92	119.60	12.08	15.91	17.31
Alanine	1.48	9.69	1.98	2.59	5.54

Arginine	19.39	8.73	25.40	9.98	4.17
Glycine	1.23	0.81	0.10	0.17	0.21
Serine	0.51	4.31	0.51	0.77	0.74
Tyrosine	4.82	13.87	0.56	2.24	1.50
Proline	2.59	1.67	0.04	1.03	0.74

*FAO/WHO/UN (1985) reference pattern.

Alanine content of Corn flour was found to be 1.48mg/100g, it was increased after supplementation with 3, 5and 7% Soya bean flour protein to 1.98, 2.59and 5.54mg/100g, respectively. Arginine content of Corn flour was found to be 19.39mg/100g; it was increased after supplementation with 3% Soya bean flour protein to 25.40mg/100g, but it was decreased after supplementation with 5and 7%Soya bean flour protein to 9.98, 4.17 mg/100g, respectively. Histidine content of Corn flour was found to be 0.32mg/100g; it was increased after supplementation with 3% Soya bean flour protein to 17.43mg/100g, while it was decreased of those supplemented flour with 5and 7%Soya bean flour protein to 3.97, 3.49mg/100g, respectively. Phenylalanine content of Corn flour was found to be 4.66mg/100g, it was increased after supplementation with 5% Soya bean flour protein to 10.27mg/100g, while decreased after supplementation with 3and 7%Soya bean flour protein to 0.79, 1.98mg/100g, respectively. Valine content of Corn flour was found to be 3.12mg/100g, it was increased after supplementation with 5% Soya bean protein to 4.00mg/100g, whereas decreased after supplementation with 3and 7%Soya bean protein to 0.68, 1.81mg/100g, respectively. Isoleucine content of Corn flour was found to be 3.70mg/100g; it was increased after supplementation with 7% Soya bean flour protein to 8.83mg/100g, while decreased after supplementation with 3and5%Soya bean flour protein to 0.22, 3.15mg/100g, respectively. Lysine content Of Corn flour increased after supplementation with 7% Soya bean flour protein to 4.12mg/100g4.97mg/100g, while it was decreased when supplemented with 3and5%Soya bean protein to 0.2, 2.58mg/100g, respectively. Lysine content of corn flour was increased from 4.12 mg/100gto 4.97mg/100g of flour supplemented with 7 % soy bean protein , while it was decreased of those supplemented with 3 and 5% to 0.2 and 2.58 mg/100g ,respectively. Cysteine content of Corn flour was found to be 1.06mg/100g; it was increased after supplementation with 7% Soya bean flour protein to 8.71mg/100g, while it was decreased after supplementation with 3and5%Soya bean flour protein to 0.53, 3.11mg/100g, respectively. Serine Content of corn flour was found to be 0.51mg/100g; it was not changed after supplementation with 3% Soya bean protein 0.51mg/100g; while it was increased after supplementation with 5and 7% Soya bean protein to 0.77,0.74mg/100g; respectively. The Amino acids Glycine, Threonine, Proline, Tyrosine, Methionine contents of Corn flour protein were found decreased after supplementation with 3,5and7% Soya bean flour. The reason may be due to racemization process which occurred to converted L. amino acids to D. amino acids. The conversion is of important nutritionally because D. amino acids are absorbed more slowly than the corresponding L. form and even if digested and absorbed, most D isomers of essential amino acids are not utilized by humans, In addition, L – D, D – L, and D – D peptides bond introduced during the racemization process would resist attack by proteolytic enzymes, which function best with L – L bond, The result obtained was agreed with that reported by (Mohammed Nour et al., 2015) who found that Supplementation with 10 and 15% fenugreek seeds protein decreased part of amino acids when compared to those after supplementation with 5% fenugreek seeds protein.

As shown in Table 2 ,The amino acids Aspartic acid, Glutamic acid, Serine contents of Corn flour supplemented with 3 ,5 and 7% Soya bean flour protein were increased after cooking , but the amino acids Glycine , Arginine , Threonine , Tyrosine , Phenylalanine contents of Corn flour supplemented with 3 ,5 and 7% Soya bean flour protein were decreased, whereas the alanine content of Corn flour was increased after supplementation with 7% Soya bean flour proteinto3.39mg/100g; but it was decreased after supplementation with 3and 5% Soya bean protein to 0.65,0.94mg/100g, respectively.

Table 2: Effect of cooking on amino acids composition of composite four

Amino acids	Composite flour			Cooked		
Essential Amino acids	3%	5%	7%	3%	5%	7%
Histidine	17.43	3.97	3.49	1.92	2.53	3.41
Isoleucine	0.22	3.15	8.83	8.02	8.55	7.25
Leucine	0.15	2.14	5.99	5.36	5.71	8.84
Lysine	0.20	2.58	4.97	4.52	4.82	4.08
Methionine	1.58	0.57	0.61	11.18	11.92	17.24
Phenylalanine	0.79	10.27	1.98	1.78	1.90	1.61
Threonine	0.63	0.93	1.98	0.54	0.59	2.31
Valine	0.68	4.00	1.81	5.84	6.22	4.28
Non-essential Amino acids						
Aspartic acid	3.57	4.78	7.21	3.18	5.38	6.86
Cysteine	0.53	3.11	8.71	7.93	8.46	7.17
Glutamic acid	12.08	15.91	17.31	13.79	18.49	25.34
Alanine	1.98	2.59	5.54	0.65	0.94	3.39
Arginine	25.40	9.98	4.17	0.29	3.27	1.24
Glycine	0.10	0.17	0.21	0.29	0.28	0.51
Serine	0.51	0.77	0.74	0.53	0.68	0.93
Tyrosine	0.56	2.24	1.50	2.00	3.12	1.70
Proline	0.04	1.03	0.74	1.25	1.95	1.06

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