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Research Article

Evaluation of amino acid composition and protein solubility profile of commercially available sesame and groundnut seed meal

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Abstract

Sesame and groundnut are important crops and a source of edible oil and protein. Amino acid content of both meals was analyzed and studies made on the protein solubility of defatted sesame and groundnut meal in aqueous solution over various pH and in various salt solutions. Valine, isoleucine, arginine, aspartic acid and glutamine were present in high concentration in both the defatted meals. Apart from these amino acids high levels of leucine and phenyl alanine were also observed in groundnut meal. The protein solubility was found to be more in alkaline pH than in acidic pH in aqueous solution and the solubility was found to be high at pH 10. Protein solubility of sesame and groundnut meal was high at 0.8M solution of sodium sulphite, 0.4M solution of ammonium sulphate and 0.2M solution of disodium phosphate. In sodium chloride solution it was observed that the solubility was high at 0.6M for sesame meal and 0.8M for groundnut meal.

Keywords: Sesame meal, groundnut meal, animal feed, India

Introduction

Plant oilseeds constitute a major source of protein and they are the important unconventional sources of protein. The defatted meal after oil extraction is added to several food preparations like bread, biscuits, cookies and as ingredient in live stock feeds. Groundnut (*Arachis hypogaea L.*) and sesame (*Sesamum indicum L.*) are the major oil seed crops of India. Groundnut is mainly used for oil extraction and the by products are utilized for feed and food purposes [1, 2]. Ground nut meal is a good vegetable protein for poultry feed.

Sesamum indicum, L. is an important crop widely cultivated all over the world. Seeds of sesame are used to garnish bread loafs, in preparation of sweets and desserts and after extraction of oil is used as a cattle feed [3]. Since antiquity sesame meal has been used for human and animal nutrition. It was also reported that sesame seed meal can be incorporated at a higher level in the diet of fish fingerlings after suitable processing [4]. Oil free sesame contains 40-50% protein. It is necessary to modify the meal so that it could be used for human consumption.

The aim of the present investigation is to study the amino acid content and the solubility profile of protein in various salt solutions for better extraction and valuable utilization.

Materials and Methods

Samples of de-oiled commercially available groundnut and sesame seed meal were collected from Chengalpet, Tamilnadu, India. The meals were powdered and used for the estimation. The amino acid assay was carried out at the Central Institute of Brackish Water Aquaculture (CIBA), Chennai, Tamilnadu, India, using high performance liquid chromatography (HPLC). Aliquot quantities of 50-100mg were accurately weighed for hydrolysis with 6N hydrochloric acid at 120ºC for 24 h in sealed glass tube. The sample was cooled and acid was removed under vacuum. The dried tubes were kept in sodium hydroxide desiccator to remove traces of acid from sample. The hydrolyzed amino acid samples were brought into solution and filtered through microfilters of 0.4micron. The filtered sample solution was injected in HPLC and amino acid analysis was carried out in Shimadzu LC-10A HPLC. The individual amino acids were detected using post column derivatization with orthopthalaldehyde in fluorescent detector. The quantitative estimation of amino acid was done using Sigma amino acid standard for fluorescent detector.

Protein solubility profile was determined by the method of Guerra and Park [5]. The commercially available meal was defatted to remove the residual oil by several extractions with chloroform: methanol at room temperature until the oil content was less than 1%. Residual solvent was removed and the meal dried in air and sieved. The fine fraction was used for protein solubility test.

Extraction of protein

Extraction of protein from meal was carried out at room temperature for 30 minutes using distilled water to meal ratio of 15:1 (v/w). The pH of extraction was adjusted to 2,3,4,5 and 6 by adding 0.5M hydrochloric acid and adjusted to 7,8,9,10,11 and 12 by adding 0.5 M sodium hydroxide. The pH was rechecked and readjusted after 30 minutes. 2.0g samples were used for protein extraction, and the volume of solution was brought to 30ml after final pH adjustment. After centrifugation at 8200xg for 20 minutes, the suspensions were filtered through Whatman filter paper no 1 to remove insoluble materials. 0.02 ml of the aliquot of each extract was used for protein estimation [6].

Protein solubility profile of groundnut and sesame seed meal in several different salt solutions such as sodium chloride, sodium sulphite, disodium hydrogen phosphate, and ammonium sulphate were carried out in varied concentrations of salt solutions (0.2, 0.4, 0.6, 0.8, 1.0 M) at pH 8.0 adjusted by the addition of 0.5M sodium hydroxide.

Results and Discussion

Table 1 shows the presence of essential amino acids of sesame and groundnut meal. Sesame meal contains a high level of valine , isoleucine (more than 2%) and groundnut meal contains a high level of valine, isoleucine, leucine and arginine. Phenyl alanine level was found to be higher in groundnut meal. Table 2 presents the non essential amino acids in sesame and groundnut meal. Aspartic acid and glutamine are found to be in high concentration in sesame meal and groundnut meal. That both essential and non-essential amino acids are present in the meal shows the richness of protein in the meal. Johnson *et al* [7] reported that sesame protein has a unique balance of amino acids and it performs better than other oil seeds in baking applications. It was also observed that defatted sesame meal is very important as a protein source for human consumption due to the presence of sulphur containing amino acids mainly methionine [8]. Gandhi and Taimini [9] have reported that de-hulled and defatted sesame meal has potential use in food products as a protein supplement and could be utilized for edible purposes.

Table 1. Essential amino acids of sesame meal and groundnut meal.

Amino acid	Sesame meal (%)	Groundnut meal (%)
Valine	2.2004	2.9705
Methionine	0.2896	0.3394
Isoleucine	2.1997	2.0425
Leucine	1.0828	2.0656
Tyrosine	0.7335	0.867
Phenylalanine	1.1842	1.7052
Histidine	0.6505	0.5785
Lysine	0.7126	0.4582
Arginine	1.8154	3.3551

Table 2. Nonessential amino acids of sesame meal and groundnut meal.

Amino acid	Sesame meal (%)	Groundnut meal (%)
Aspartic acid	2.9254	3.6182
Threonine	1.3269	1.9403
Serine	1.1203	1.4528
Glutamine	4.873	3.9025
Proline	0.6629	1.799
Glycine	1.2989	1.4446
Alanine	1.1281	1.7279
Cysteine	0.116	0.4921

The high levels of glutamic acid and aspartic acid in the sesame meal agrees with the result reported by Bahkali *et al* [10]. Inyang and Wayo [11] have reported that de-hulled sesame seed meal was used to fortify cookies and the protein content of the cookies increased. It was quoted by Asibuo *et al* [12] that groundnut cake after oil extraction contains nearly 40-60% protein. The defatted meal after oil extraction is an ingredient in livestock feed, added to several cereal based preparations for infants to improve the diets of malnourished people in developing countries.

Table 3. Protein solubility (mg of protein/g meal) of sesame meal and groundnut meal in aqueous solution at various pH.
(values are expressed as mean ± SEM for six replicates)

pH	Sesame meal	Groundnut meal
2.0	1.012 ± 0.20	1.125 ± 0.106
3.0	1.185 ± 0.19	1.136 ± 0.037
4.0	1.323 ± 0.09	1.2 ± 0.10
5.0	1.411 ± 0.21	1.218 ± 0.027
6.0	1.5 ± 0.212	1.894 ± 0.345
7.0	1.565 ± 0.36	2.64 ± 1.2
8.0	1.782 ± 0.18	2.765 ± 0.58
9.0	2.105 ± 0.559	3.975 ± 0.53
10.0	3.555 ± 0.806	4.387 ± 0.208
11.0	3.05 ± 0.487	4.225 ± 0.624
12.0	2.06 ± 0.74	4.087 ± 0.194

Table 4. Protein solubility (mg protein/ g meal) level of sesame meal and groundnut meal in different concentrations of sodium chloride, sodium sulphite, ammonium sulphate and disodium hydrogen phosphate solutions.
(values are expressed as mean ± SEM for 6 replicates)

Salt solutions	Meal	0.2M	0.4M	0.6M	0.8M	1.0M
Sodium chloride	Sesame	3.50± 0.10	4.10 ±0.15	4.35±0.18	3.95±0.12	3.80±0.20
	Ground nut	3.75±0.21	5.05±0.27	5.40±0.34	5.55±0.29	5.45±0.37
Sodium sulphite	Sesame	9.975±0.9	10.35±1.0	11.10±0.9	12.60±1.4	11.92±1.1
	Ground nut	9.60±0.81	9.82±0.9	10.35±1.2	11.55±1.0	11.02±0.9
Ammonium sulphate	Sesame	4.95±0.21	10.65±0.9	7.35±0.42	7.05±0.39	6.75±0.34
	Ground nut	12.75±1.2	13.20±1.4	11.1±1.3	6.45±0.49	5.85±0.32
Disodium hydrogen phosphate	Sesame	8.85±0.83	6.60±0.42	6.45±0.53	6.00±0.42	5.40±0.32
	Ground nut	12.75±1.09	11.10±1.4	10.5±0.96	10.35±0.9	8.70±0.59

Protein solubility profile of sesame and groundnut meal in aqueous solution at various pH is shown in Table 3. It was observed from the results that protein extraction was found to be higher in alkaline pH than in acidic pH. The solubility was found to be high at pH 10. Protein solubility levels of sesame and groundnut meal in different concentrations of various salt solutions were shown in Table 4. Protein solubility was found to be high at 0.8M concentration of sodium sulphite, 0.4M concentration of ammonium sulphate and 0.2M concentration of disodium

hydrogen phosphate for sesame and groundnut meal. In sodium chloride solution, solubility was found to be high at 0.6M for sesame meal and 0.8M for groundnut meal.

Conclusion

Sesame and groundnut meal are a rich source of protein as shown by the presence of both essential and nonessential amino acids. The high protein solubility characteristics of sesame and groundnut meal in various salt solutions can be used to prepare a protein isolate and that could be used for commercial preparations, fortifications and improving nutritional status.

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