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ISOLATED PROTEIN FROM CASTOR BEAN, PEANUT, SOY BEAN AND SAFFLOWER MEALS

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ABSTRACT

Castor beàn, peanut, soy bean and safflower protein isolates were prepared. The amino acid content of each of the protein isolates was analysed and the essential amino acid contents were compared with the FAO human requirements. The results indicated that castor bean has the highest oil and the protein content of defatted meal. Safflower 3148 (Marand) has the highest amount of essential amino acids. Peanut (Gilan Iran) has the lowest content of essential amino acids, however, in comparison to human requirement 100 gram protein of this peanut still have enough amino acid for one man's day. The ash total protein and total oil of the mentioned seeds were also determined.

INTRODUCTION

The world food supply, particularly of protein foods, is presently precarious, and both acute and chronic regional shortages are anticipated if the world population continues to increase as predicted. More food protein will be needed from both conventional and nonconventional sources, particularly the latter, because of the finite limitations on land

and energy. Many approaches toward increasing the supply and the nitritive value of foods and proteins have been proposed, and research is in progress on several sources. Thus, proteins from oilseeds, grains, legumes, fish, microbes, algae and leaves are being investigated. In recognition of the magnitude of future world needs, it is expedient to examine all potential sources (1).

The object of this present investigation was to determine the protein content and amino acid composition of some Iranian crops currently cultivated for oil. The meal of hulled castor bean peanut, soybean and safflower, after oil extraction and desolventization under low temperature conditions, were prepared. The amino acid composition of protein isolates prepared from the defatted meals were also determined. The essential amino acid contents of the isolates prepared from the various oilseeds were compared with FAO amino acid human requirements; some other characteristics of these crops such as oil content, ash content and hull percentages, are also reported.

EXPERIMENTAL PROCEDURES

Seed samples: The seed samples were generally obtained from Seed and Plant Improvement Institute, Karaj, Iran, in 1974. suf-flower varieties *(Cartamuse tinctorious)* were Mashad-3150, Marand-3148, and Arac-2811. Peanut *(Arachis hypogaea)* varieties were Local Gilan, Iran, a native Iranian peanut, Georgia-119-20 and Flori Spanish 334-A that had been cultivated in Iran for more than eleven years. The soybean *(Glycine Max L)* variety used was Local Hill, that had been cultivated in Iran more than 30 years, and castor bean *(Ricinus Communis)* Local Mahabad, Iran, were also studied.

***Oil,** ash and crude protein determinations:* The ash, oil and shell percentage of each variety was measured according to methods discribed in AOAC (2). Seed and meal crude proteins were determined by micro-Kjeldahl method discribed by Pearson (3), using Bushy Glase Parate Model 620-778, Switzerland. Nitrogen content of each sample was determined in triplicate.

Protein extraction and Isolation: Protein extraction and isolated protein preparation were carried out by the method of Sosulski and Sarwar (4). Oil was extracted from the hulled ground seeds, with hexane, in Soxhlet apparatus for 24 hours. After desolventization over night at 45°C, protein was extracted from defatted meal with 0.2%

NaOH for two hours. Protein was precipitated from the extract at the isoelectric point of each oilseed meal. The pH of minimum solubility for the extracted proteins was 5.0 for safflower (5), 4.5 for soybean (5), 3.9 for peanut (6) and 4.0 for castor bean.* These protein isolates were then washed and aceton-dried and used for amino acid analysis.

Amino acid composition determination: The protein isolates were hydrolyzed in 6 N HCl at 110°C for 24 hours and neutralized by evaporating excess HCl. This extract was analysed by Jeol Model JLC 6AH Japan, amino acid analyser (7).

RESULTS AND DISCUSSION

The results of these experiments are given in Table I, II and III. As Table I indicates, seeds contain about 20-49% protein and 17-46% oil. Castor bean has the highest percentage 46% of oil, which generally has some technical and pharmaceutical use. Castor bean meal also has the highest protein content (75%); however, the direct use of this protein in food is inhibited due to its toxicity. Soybean contains 36% crude protein, and the meal contains 44% protein. These values generally agree with those reported Altschul (8) and Inglet (9). safflower seed has a relatively low meal protein concentration, but the oil, though in a lower concentration in comparison to peanut, is a cheap oil for market use. This makes cultivation of these seeds more economical and important. As table I indicates, there are some differences between varieties for all the oilseeds species. For example Local Gilan has a higher meal protein, and a lower oil content than other peanut varieties.

The amino acid content of protein isolates of seed varieties are given in Table II. Almost all amino acids are present in the meal protein investigated.

Table III compares the essential amino acid content of isolated proteins with FAO recomended values for human requirement (10). Relative to human requirements safflower 3148 was the richest in essential amino acids. Native Iranian peanut, Local Gilan, has the lowest concentration of these amino acids, though 100 g of peanut

* In the case of castor bean, isoelection point was found by lowering the pH to a point were most of the protein are precipiated.
Lowering the pH of the supernatant did not lead to more precipiation.

protein still has enough essential amino acids for man's one day. It is also not contaminated with aflatoxin (11). This detoxified rich protein (Table I) peanut could be used as such in nutrition without being concidered a potential threat to food safety and human health.

safflower 3150 was the most concentrated raw material for extraction of protein. This variety not only contained a high concentration of protein, but it was also rich in essential amino acids, specially leucine. As table I shows, castor bean has a high protein content too. However, the seed is toxic, and could be introduced in human or animal food, if its toxicity could be over-come. Thus it may have a great economical and nutritional importance in manufacturing of isolated protein.

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TABLE I

Species and varietal differences in kernel size (%) and proximate (%) analysis of Iranian soy bean, safflower, castor bean, and peanut seeds[a].

Crop and Variety	Kernel	Crude Protein[b]	Oil	Ash	Meal Protein[b]
Soy bean	82.35	36.57	17.40	6.20	44.04
Safflower 3150	53.41	49.13	26.14	4.48	57.81
3148	52.45	31.01	28.03	4.44	57.97
2811	55.46	44.23	23.96	4.48	58.88
Castor Bean	66.54	45.03	46.30	3.55	75.53
Peanut Georgia	85.65	20.19	43.45	2.28	42.02
Flori Span	70.11	22.52	42.49	2.78	46.48
Local Gilan	72.28	23.86	38.42	2.79	49.36

a On a wet basis sis

b Conversion factor (5.5) was used for calculating total protein(5).

TABLE II

Varietal Differences In Amino acid — Composition of Four Oilseed Crops (g amino acid/100 g protein isolate).

Amino acid	Soy Bean	Safflower			Castor bean	Peanut		
		3150	3148	2811		Georgia	Flori Span.	Local Gilan
Essential for Human Requirement								
Isoleucine	3.60	10.25	6.23	2.98	2.61	1.42	1.07	1.10
Leucine	2.85	14.32	10.77	9.09	3.43	4.69	7.03	5.82
Lysine	3.54	2.86	3.58	5.19	2.26	3.04	3.37	1.09
Mellionine	2.50	2.21	1.55	2.65	3.01	2.37	0.90	0.57
Cystine	1.05	-	1.92	-	0.96	-	-	1.07
Phenylalanine	7.26	10.83	6.89	4.14	5.57	3.18	5.22	3.91
Threonine	4.56	3.09	2.92	11.82	4.29	2.60	2.29	2.01
Valine	4.03	10.20	7.76	3.32	3.02	1.66	3.52	2.51
Non Essential For Human Nutrition								
Alanine	14.49	4.12	7.57	12.10	8.08	5.71	5.63	5.30
Arginine	10.51	4.18	17.15	10.39	14.24	2.06	2.59	0.76
Aspartic acid	7.06	1.06	7.28	3.57	7.49	14.43	9.05	16.43
Glutamic acid	1.08	8.24	2.33	1.51	6.21	19.27	23.95	17.53
Glycine	4.61	5.75	5.51	8.63	5.09	6.57	5.23	5.67
Proline	7.01	2.21	6.13	9.48	4.46	*	*	*
Histidine	2.96	7.68	3.97	5.21	3.34	2.06	2.59	0.86
Serine	4.14	7.32	2.72	5.78	5.26	4.77	5.79	4.04
Tyrosine	6.39	9.59	4.96	4.88	3.39	2.13	4.31	3.32
Total	87.72	103.91	99.25	100.69	108.21	82.14	82.46	73.75

*Was not determined due to instrumental failure.

TABLE III

Relationship of the EAA composition (g amino acid/ 100 g protein isolate) to human requirements (man) (FAO, WHO, 1973).

Amino acid	FAO* g/d	Soy bean	Safflower 3148	Castor bean	Local Gilan
Isoleucine	0.73	3.60	6.23	2.61	1.70
Leucine	1.10	2.85	14.32	3.43	5.82
Lysine	0.80	3.54	3.58	2.26	1.10
Methionine&cyctein	1.10	3.55	3.47	3.97	1.64
Phenylalanine&tyrosine	1.10	7.26	6.89	5.57	3.91
valine	0.80	4.03	7.76	3.02	2.51
threonine	0.50	4.56	2.02	4.29	2.01

± Essential amino acids

* Average protein requirement (g/Kg/day) adult was 0.55 (12).

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