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Technical Paper

Studies on the Production of Defatted Sunflower Meal with Low Polyphenol and Phytate Contents and its Nutritional Profile

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Abstract: A simple process was developed for making low poly phenol and phytate sunflower meal. This meal contains 58% proteins, 0.2% phytates and 0.3% poly phenols. This meal may be used directly for food fortification to enrich the nutritional profile of traditional diets and also a feeding stock for protein isolation.

Keywords: Defatted sunflower meal, poly phenols, phytates, minerals

INTRODUCTION

Sunflower (*Helianthus annus* L) is an important oilseed and in India, about 1.85 million metric tons was produced in 2005. The protein content of sunflower cake ranges from 20-40% and in view of its economic significance and non-availability of sufficient animal protein, there is a great scope for utilization of oil cake proteins for human consumption. The meal is a valuable source of protein. There are no toxic constituents and anti nutritional factors in sunflower meal (Theertha, 1990). Therefore, the defatted sunflower meal has been considered as a potential source of vegetable protein for human consumption. The bland flavor, light color and absence of antinutritional or allergenic compounds has prompted the utilization of the oil cake for human consumption (Diaa El - Din and Farag, 1999) which is otherwise traditionally used as an animal feed. Sunflower proteins contain adequate levels of essential amino acids. However, sunflower seeds also contain large amounts of phenoloic compounds especially chlorogenic, quimic and caffeic acids. They complex with proteins, cause discoloration of the protein isolates and lower the nutritional value due to their interaction with amino acids (Smith and Jhonsen, 1948). Many methods such as irradiation of seeds, heat-moisture treatments, and solvent exposure have been proposed earlier to remove these phenolic compounds and phytates but their effectiveness at removal was very minimal due to the strong hydrogen bonding between hydroxy groups of phenolic compounds and the peptide bonds (Samanthaka and Subramanian, 1985). Hence the objectives of this study were to develop simple methods for reducing the polyphenols and phytates from sunflower cake and evaluate its nutritional profile.

MATERIALS AND METHODS

Seed

Commercial variety of sunflower was procured from the local market. It was cleaned, graded and dehulled manually.

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Preparation of Defatted Sunflower Meal

The dehulled seeds were flaked to 0.3 mm thickness using a three roller flaking machine and later the solvent was extracted using food grade n-hexane. The oil-extracted flour was dried at room temperature for 24 h and finally dried to remove the traces of solvent through vacuum drying at 60°C. This flour was used for all the experiments.

Physico Chemical Composition and Nutritional Analyses

The seeds were analyzed for moisture content, crude protein, crude fat, fiber, ash, minerals (Zn, Fe, Cu, Mn, P, Ca and Mg), and poly phenols using AOAC (1990) methods. The phytate was evaluated using the procedure suggested by Latta and Eskin (1980). It is a simple and rapid colorimetric method which comprises of passing the sample through an anion exchange resin and eluting with 0.7 M NaCl. The phytate content in the eluent was determined by reaction with Wade reagent and read at 500 nm.

Treatments Heat

Sunflower flour was suspended in SS trays to a 0.5 mm thickness, covered to minimize moistening with condensed steam and autoclaved at one kg cm^{-2} (120°C) for 60 min and then air dried to uniform moisture levels. Similarly the meal was directly dried under vacuum at 60°C for one hour. The targeted moisture was less than 10%. The samples were ground to pass through 65-mesh screen before analysis.

Solvents

A solution having 40% acetone, methanol or ethanol in water at a meal to solvent ratio of 1:10 (w/v) was prepared and shaken for 2 h. The extraction was done at room temperature and repeated until the supernatant showed a negative test for cholorogenic acid. The slurry was filtered under suction, dried in a current of air at 35°C, powdered and passed through 60-mesh sieve (BSS). Extraction with water (pH 6.0) was carried out at 70°C with meal to solvent ratio of 1:10 (w/v). For each, the extraction was done five times and for 1 hr. The extract was removed by filtration and the residue was dried in air current at 35°C, defatted with hexane, powdered and passed through 60-mesh sieve. To study the effect of pH on the extractability of protein and phytate, the meal or the solvent cake was mixed with water (1:50 w/v) and stirred at low speed for 30 min. The desired pH was maintained with 0.5N HCl or NaOH and centrifuged. The phytate content was determined in the supernatant. The defatted sunflower meal was later mixed with $NaHCO_3$, $Ca(OH)_2$, NaCl, acetone, HCl, distilled water, ethanol, methanol and sodium sulphite at a meal to solvent ratio of 1:50 (w/v) and shaken for 24 hrs at low speed with a mechanical shaker. The extraction was repeated until the supernatant resulted in a negative test for poly phenols.

RESULTS AND DISCUSSION

Data on chemical composition, physical characteristics and minerals present in whole sunflower kernels are shown in Table 1. The crude protein and fat contents were 21% and 56% respectively, and crude fiber was 16%. Among the minerals, phosphorus content was the highest with 844 mg $(100g)^{-1}$ kernels. The proximate composition of defatted sunflower meal is presented in Table 2. The data indicate that the meal contains 57.4% protein with phytates and poly phenols being 1.2% and 4.27% respectively. Different methods of processing were adopted to lower the poly phenols in the sunflower meal. The results are shown in Table 3.

The results show that maximum reduction of poly phenols was attained with aqueous acetone followed by 0.5M HCl treatments. These results were better than the reported values of Sripad and Narasinga (1987). Similarly studies were conducted to lower the phytate levels through pH shocks. The data in Table 4 shows that the maximum reduction

Table 1
Physicochemical characteristics of sunflower seeds

Characters	Values
Crude Protein, %	21.0
Crude Fat, %	56.0
Crude Fiber, %	16.0
Ash, %	3.0
Moisture content (wb), %	7.0
1000 grain weight	31.4
Bulkdensity, m^3	0.61
Kernel, %	75.3
Hulls, %	24.7
Size, mm	
Width	4.7
Length	9.2
Thickness	3.1
Minerals.mg $(100g)^{-1}$	
Calcium	50.0
Magnesium	48.0
Phosphorus	844.0
Zinc	0.04
Manganese	0.14
Iron	0.16
Copper	0.02
Potassium	0.4

Table 2
Proximate composition of sunflower meal

Constituents	Values (%)
Crude Protein	57.4
Crude Fat	0.8
Crude Fiber	21.0
Ash	6.4
Phytates	1.2
Polyphenols	4.27

was achieved at pH 5.0 - 5.5. The results concur with those of Bulmaga *et al.* (1989). The sunflower meal with the optimized treatments was analyzed for its proximate composition, phytates and poly phenols. The results as shown in Table 5 reveal that the meal contains

Table 3
Polyphenols in sunflower meal after processing

Treatment	mg $(100g)^{-1}$
Control	4270
Absolute ethanol	530
Sodium sulphite, 1%	220
Deionized water	1740
Sodium bicarbonate, 0.5%	2594
Sodium chloride, 5%	1995
Calcium hydroxide, 1%	2905
Methanol	445
Acetone aqueous	40
Hydrochloric acid, 0.5M	50
Dry heating	150
Autoclaving	100

Table 4
Levels of phytates in sunflower meal after washing with water of various pH

Treatment (pH)	mg/100g
Control	1200.00
pH 2.0	0.97
pH 2.5	0.94
pH 3.0	0.80
pH 3.5	0.66
pH 4.0	0.43
pH 4.5	0.23
pH 5.0	0.09
pH 5.5	0.09
pH 6.0	0.66

Table 5
Composition of sunflower meal after lowering poly phenols and phytates

Constituents	Values (%)
Crude Protein	58.0
Crude Fat	0.7
Crude Fiber	18.0
Ash	7.6
Phytates	0.2
Polyphenols	0.3

58% crude protein, and 0.7% crude fat. The residual poly phenols and phytates were 0.3 and 0.2% respectively.

CONCLUSION

A simple process was developed for making defatted sunflower meal with low profile phytates and poly phenols. This meal can be safely used for human consumption as well for value addition like protein isolation without discoloration of the proteins.

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