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Sunflower seed protein concentrates and isolates obtention from ethanol oil extraction meals - (Technical note)

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SUMMARY. The objective of this work was to study and identify the necessary processing steps for obtaining good quality sunflowerseed protein concentrate and isolate when the oil is extracted with ethanol. This work is part of a research project on using ethanol as renewable solvent for sunflower seed oil recovery and possible further processing of the meal. Both 99°GL and 90°GL ethanol were employed in the extractions to produce the concentrate. Isolates were obtained by treating the concentrate with NaOH and HCl solutions and final rinsing with acidified water. Both products were light in color and almost free from chlorogenic acid.

RESUMEN. Obtención de concentrados y aislados proteicos de harinas de semillas de girasol tratadas con alcohol etílico. Este trabajo fue desarrollado con el objetivo de observar e identificar los pasos necesarios para la obtención de concentrado y aislado proteicos de buena calidad de semillas de girasol sometidas a la extracción del aceite con etanol. Los ensayos son la continuación de una investigación a nivel de laboratorio sobre el empleo del alcohol etílico como solvente renovable para la extracción del aceite y posterior utilización de la harina. El concentrado fue obtenido de harinas producidas por extracción del aceite de las tortas con mezclas hidroalcohólicas de 99°GL y 90°GL. El aislado proteico fue producido sometiendo el concentrado a soluciones de NaOH y de HCl y lavándolo al final con agua acidificada. Los dos productos se presentan muy claros y casi totalmente libres de ácido clorogénico.

INTRODUCTION

From the nutritional point of view sunflower seed protein is among the best in the oilseeds due to its content in essential amino acids and absence of antinutritional factors (1). According to Galoppini and Fiorentini (2) the kernel is constituted mainly of lipids and proteins, and the pericarp almost totally of glucidic substances (cellulose, hemicellulose and lignin) and waxes, which require dehulling of the seed.

Solubility of the protein is of great interest in obtaining protein concentrates and isolates. Smith and Johnsen (3) studied the solubility of sunflower seed nitrogen compounds as a function of pH and found that their minimum solubility is in the range of pH 3 to 7, which was also confirmed later (4,5). The highest solubility of sunflower occurred at alkaline pH's (6). The low dispersibility of sunflower protein in water was attributed to the presence of chlorogenic acid, which when present in the meals also caused darkening of the protein concentrates and isolates (7). Brummett and Burns (8) and others (9,10) found higher chlorogenic acid contents in sunflower kernels than in the hulls, which confirmed that the hulls left on the seeds were not the main responsible for the dark green color of protein products.

Several solvents were evaluated regarding their ability to remove chlorogenic acid from sunflower meals. Gheyasuddin et al (4) employed both aqueous 25% sodium sulphite solution at pH 10.5 in the proportion 1:10 (m/v) and 50% aqueous isopropanol in extraction trials. Citric acid and boiling sodium bisulphite solutions produced light color meals, the first lighter than the latter (11). N-butanol and 0.005N hydrochloric acid (92:8) were successfully employed in obtaining low chlorogenic acid content meals (12). Rossi et al (13) used aqueous ethanol 1:5 (m/v) and also reduced the chlorogenic acid concentration.

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Previous work (14) demostrated that it is technically feasible to extract the oil and the chlorogenic acid from the seeds and sunflower cakes by ethanol at different water-alcohol ratios.

The objective of the present work was to study and determine the necessary steps for obtaining sunflower protein concentrates and isolates from the meals where oil was extracted with ethanol.

MATERIAL AND METHODS

Anhandy var., oil-type, sunflower seeds were used. The hulls, kernels, meals, concentrates and isolates were analysed for oil content (15), moisture content (16) and crude protein content (17) using the conversion factor 6.25. Cholorogenic acid was determined according to the colorimetric method of Bittoni et al (18).

Chlorogenic acid free protein concentrate

1st. trial. Kernels ground through sieve Nº 10 were extracted five times with 99°GL ethanol in the ratio of 1:5 (m/v) initially and 1:4 (m/v) in the last four, for 15 minutes each, using water bath at 75°C and magnetic stirring to recover the oil. The same rates and times were used for the 90°GL extractions. The product was filtered, rinsed with water, and air dried at ambient temperature.

2nd. trial. The same procedure as above was used, except that four 90° Gl extractions were performed, instead of three.

3rd. trial. The extraction procedure was the same as above, but rinsing was done with 0.005 N hydrocholoric acid and the concentrate was dried in a forced draft oven at 40°C.

4th trial. The water bath temperature during extraction was lowered to 70°C.

Preparation of isolate

An adaptation of Sodini and Canella (12) was followed as shown in Figure 1.

RESULTS AND DISCUSSION

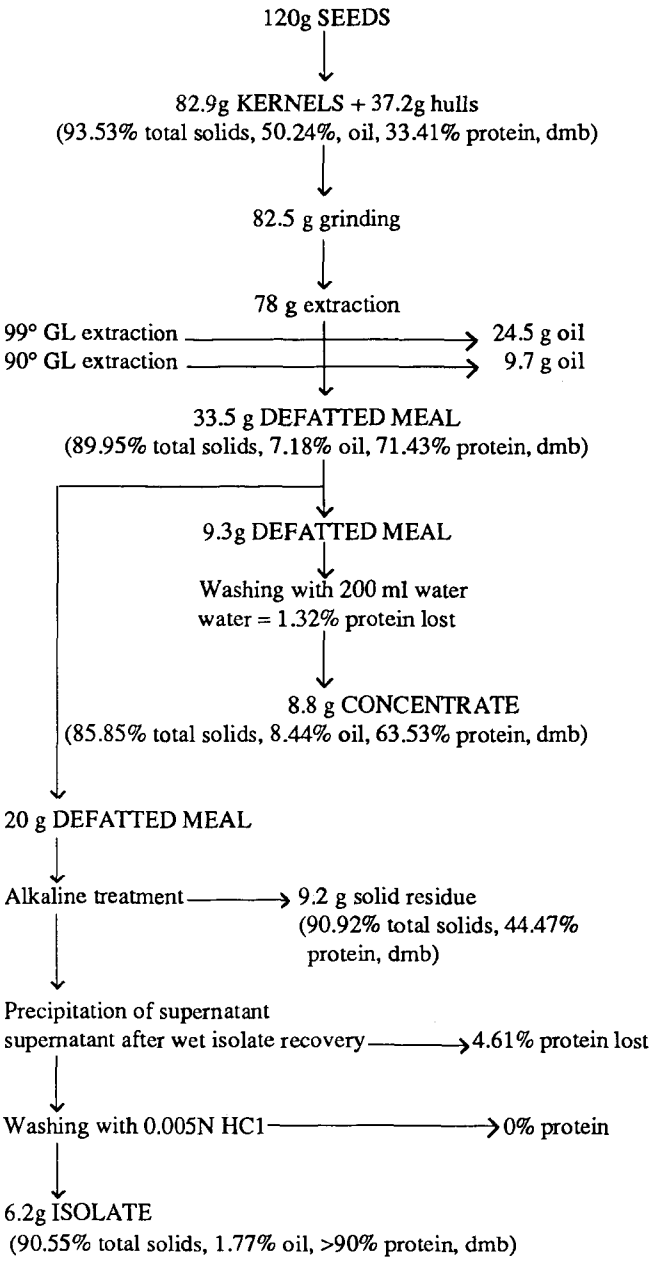
Dehulled sunflower seeds employed in Trial 1 contained 61.01% oil and 19.96% protein on a dry matter basis. The dehulled seeds used in Trials 2 to 4 contained 53.63% and 33.58% protein on a dry matter basis.

Trial 1 produced a dark beige concentrate with 1.57% oil and 62.76% protein. Trial 2 produced an isolate which was darker and contained 0.45% cholorogenic acid, due to water rinsing. Rinsing with hydrochloric acid (Trial 3) and drying at 40°C produced a better isolate (lighter in color and better in appearance and texture) with 0.05% chlorogenic acid. The lower extraction temperatures in Trial 4 resulted higher protein content in the isolate, possibly due to less protein denaturation under heat.

It was also observed that rinsing either with water or acid led to protein losses. According to Meyer (19) minimum protein content in a concentrate should be 70% and this was obtained only when rinsing was omitted.

Protein isolate was successfully produced according to the scheme in Figure 1 and its chlorogenic acid content was almost zero wich assured a good and light color. This result is a good foundation for continuation of our work in evaluating ethanol as a solvent for industrial oil extraction since its meals can be kept in the extractor and turned into chlorogenic acid free concentrates by use of diluted ethanol recovered from simple distillation of the miscella.

FIGURE 1
Concentrate and isolate obtention steps



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