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THE INFLUENCE OF CONDITIONING METHODS ON THE YIELD AND QUALITY OF SOYBEAN OIL EXTRACTION

Iuliana Vintilă
Facultatea de Ştiinţa şi Ingineria Alimentelor Galaţi, str. Domnească, 111

Abstract

The influence of crushing and roasting methods applied to soybean on the yield and quality of soybean oil extraction were investigated. The extraction yield increase to 86.43% in can of fine oilseed mill (0.25 – 0.30 mm) than 61.31% in ground oilseed mill case. A moderate condition of roasting (9% final humidity, 90°C final temperature of roasted soy) will give the best results in the terms of yield (94.68%) and quality of soybean oil (color index: 1.65; acidity index: 5.2; peroxide value: 0.6 mEq / kg) applied to fine the soybean mill.

Key words: *soybean oil, roasting, crushing.*

Introduction

The edible vegetable oils are obtained on the industrial plants, from oil seeds, conditioned by crushing and roasting. The quality of preliminary conditioning methods determined the yield and quality of oil extraction. The crushing degree and the intensity of roasting methods are technological parameters, which are selected, in a strict correlation with the nature, quality and destination of oil seed (Conner, 1990; Kamido, 1988).

The oil suds crushing in fine mill or pellets give a mechanical de-structure of oil cells from vegetable tissue, which creates the condition of molecular oil diffusion during the solvent extraction. In addition to this, a fraction of oleoplasma captive oil is expulsed as free oil on the surface of vegetable material. The degree of crushing determined the speed and the yield of oil extraction. The roasting of oil or pellets determined the optimal structure for oil extraction and the reducing of oil viscosity (Vintila, 2003).

The purpose of this study research was to evaluate the influence of the crushing degree and roasting intensity on the yield and quality of soybean oil extraction.

Experimentals

Soybean with 11.5% water content and 20% oil were crushed at two different degrees:

a) Ground mill (W_1), 100% screened on a 4 mm plane screen, 15% screened on an 1.5 mm screen;
b) Fine mill (W_2), 100% screened on a 2.5 mm screen, 15% screened on a 1.5 mm screen.

The W_1 and W_2 samples were de-oiled by petroleum better extraction by Soxhlet methods (STAS 8004 - 82). The roasting methods were applied on the fine oil mill (W_2). There were applied two different kinds of roasting:

a) Intensive (P_1): hydration of fine mill to 11,5% water content and 60°C, 10'; roasting to 8% final value of water content and 90°C;
b) Moderate (P_2): hydration to 12.5% water content and 60°C, 10'; roasting to 9% final value of water content and 90°C.

The P_1 and P_2 samples were deoiled by petroleum ether extraction by Soxhlet methods (STAS 8004 - 82).

The extraction yields were determined with the following formula:

$$\eta = \frac{O_e}{O_t} \cdot 100$$

Where: η = extraction yield, (%);
O_e = oil extracted by Soxhlet method, g;
O_t = total oil content of fine oil mill, g.

The quality of soybean oil were determined with the following quality index (Hantfenne, 1987; Walker, 1991):

1) Color index (CI), expressed as mg $K_2Cr_2O_7$ / 100 ml, with the same color intensity as the oil sample;

2) Refractive index (i_R^{20}), determined with Abbé – Zeiss refractometer;
3) Free acids index (FAI), expressed as acidity degree (g KOH / 100 g oil) and equivalents of acidity in oleic acid percent (STAS 145 / 16 - 67);
4) Peroxide value (PV), expressed as mEq active oxygen in 1 kg of oil (STAS 145 / 16 - 27);
5) Saponification index (SI), expressed as mg KOH / g of oil (STAS 145 / 16 - 67);
6) Water and volatile components (WVC) content (%) (STAS 145 / 10 - 67).

Results and Discussions

The influence of griding degree on the yield and the quality of soybean oil were presented in the Table 1. The experimental results show a better result in case of fine mill (0.25 – 0.30 mm) than ground mill (1.50 – 4.00 mm), only in terms of yield (86.42% in W_1 case, than 61.31% in W_2 case).

Table 1. The influence of grinding degree of the oil yield extraction and quality of soybean oil.

Sample	Quality index							
	η	CI	i_R^{20}	FAI		SI	PV	WVC
				KOH	oleic			
W_1	61.31	1.65	1.4705	4.0	0.53	190.9	7.3	1.12
W_2	86.42	1.70	1.4700	5.0	0.39	198.5	11.6	0.14

Soybean oil obtained from fine mill has a yellow – browny color (color index 1.70 compared to 1.65 in W_1 case), a lower value of viscosity (refraction index 1.4700 for W_2 and 1.4705 in W_1 case), and a higher value of water and volatile compounds content (0.14% compared to 1.12% in W_1 case). The increase of griding degree generated a higher face surface of oily materials determined a higher exposure to solvent extraction and a better extraction yield, but, in the same time, generated a lower oxidative resistance of soybean oil, than the oil extracted from ground mill (1.6 acidity index in W_1 case, than

2.2 in W_2 case; 7.3 mEq / kg peroxide value in W_1 case, than 11.6 mEq / kg in W_2 case).

The influence of roasting methods applied to fine mill W_2 were presented in Table 2.

Table 2. The influence of roasting methods on the oil yield extraction and quality of soybean oil.

Sample	Quality index							
	η	CI	i_R^{20}	FAI		SI	PV	WVC
				KOH	oleic			
P_1	70.93	1.68	1.4690	2.0	1.98	198.25	1.6	0.06
P_2	94.68	1.65	1.4695	1.2	1.29	185.20	0.6	0.08

A moderate conditioning of roasting gives better results than the intensive one in terms of yield (94.68% in P_2 trial, than 70.93% in P_1) and the quality of oil (color index 0.65 in P_2, than 0.68 in P_1, acidity index 5.2 in P_2 than 8 mg / g in P_1 trial; peroxide value 0.6 mEq / kg in P_2 than 1.6 mEq / kg in P_1 trial). A moderate roasting generated pellets with optimal porosity, a resistance to individual extraction and better mobility of oil in molecular diffusion process.

Conclusion

Soybean for oil extraction must have a correct conditioning, by crusting in pellets of 0.25 – 0.30 mm and moderate roasting to a final temperature of 90°C for a yield of oil extraction, which goes to 94.5% and a good quality of soybean oil.

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