REMOVAL OF SINAPINE FROM RAPESEED USING VARIOUS SOLVENTS AND EXTRACTION CONDITIONS

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INTRODUCTION

Rapeseed is the dominant oilseed grown in Poland. Despite introduction of low in erucic acid, and recently low in glucosinolate cultivars, rapeseed protein is not yet utilized as an ingredient in food products. The main reason is poor organoleptic quality of rapeseed protein products which is affected by undesirable constituents i.e. glucosinolates, phytates and phenolic compounds. While several reports have been described to eliminate/reduce glucosinolates, (Sosulski, 1978; Jones, 1979; Blaicher et al., 1983; Diosady et al., 1985) and phytates (Siy and Talbot, 1982; Serraino and Thompson, 1984; Thompson and Cho, 1984), relatively little consideration has been given to phenolic compounds from rapeseed meal. Dabrowski and Sosulski (1983) found that typical, described in literature, processes for protein concentration and isolation reduced phenolic compounds content (analysed as phenolic acids released under alkaline hydrolysis) by 60-83%. Similar reduction of phenolics content was obtained using two-phase methanol-ammonia/hexane extraction system, which produced very low glucosinolate meal (Naczk et al., 1985). Kozłowska and Zadernowski (1983) obtained protein concentrate containing only traces of phenolic compounds, however it required as much as 7 single extractions with 70% ethanol at solvent to meal ratio of 10:1

The objective of the present study was to determine efficiency of batch extraction using various solvents and mul-

tistage countercurrent extraction on the sinapine removal from rapeseed meal.

MATERIALS AND METHODS

Meal Preparation

Seeds of double improved winter rapeseed (BOH-183 experimental strain) were obtained from the experimental station. A meal sample was defatted with hexane in laboratory Soxhlet unit.

Analytical Methods

Protein (Nx6.25) was determined by the Kjeldahl method. Sinapine content was analysed, as a sinapine bisulfate by the procedure used by Mueller et al., (1978). The results are expressed as a percentage of sample, dry weight basis.

Batch and countercurrent extractions

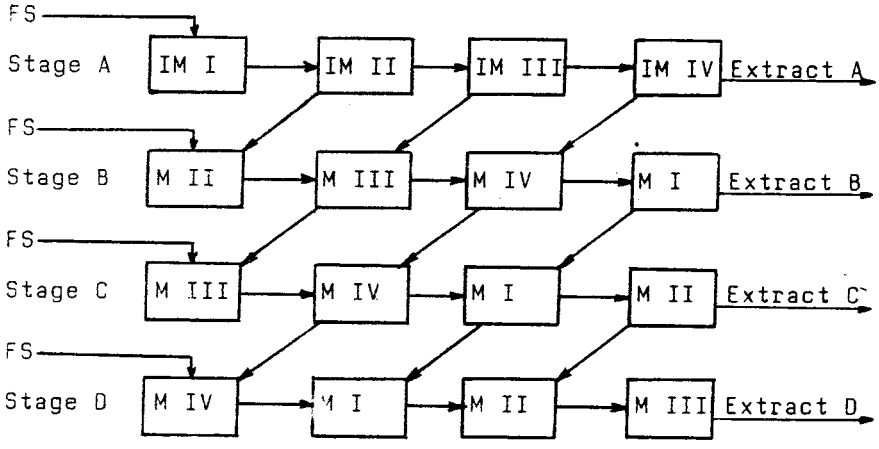

Figure 1. Scheme for countercurrent extraction of sinapine from rapeseed meal.
FS=Fresh solvent: aceton-methanol-water (7:7:6)
IM=Initial meal
M=Meal

In the batch process two successive extractions of initial meal for 30 min each, at solvent to meal ratio of 5:1 were carried out. The following fresh solvents to each extraction were used: water, 70% ethanol, aceton-methanol-water (7:7:6), methanol-ammonia water (3:2) and acidified methanol.

In the countercurrent process, four, five- and six- stage extractions with acetone-methanol-water (7:7:6) at solvent to meal ratio of 6:1 and 10:1 were used as described in Fig. 1. At each stage, extraction was carried out for 30 min using magnetic stirrer and centrifuged resulting supernatant was used to extract the next sample.

Dry meal residues obtained in both, batch and countercurrent processes are referred in this paper to as "protein meals", in order to distinguish them from initial meal and protein concentrates.

RESULTS AND DISCUSSION

Two 30 min batch extractions using following solvents: water, 70% ethanol, aceton-methanol-water (7:7:6) and methanol-ammonia water (3:2) at solvent to meal ratio of 5:1 removed 64, 74, 80 and 90% of initial content of sinapine, respectively (Tab.1). The latter solvent mixture was the most effective in sinapine removal, thus it could be used instead of aceton-methanol-water (7:7:6), which is recommended by Krygier et al. (1982) for quantitative extraction of phenolic compounds. Naczk et al. (1986) using two-phase solvent extraction with 10% of ammonia in methanol extracted 69 to 78% of total canola meal phenols, while extraction with 1M ammoniated ethanol lowered sinapine content in canola cultivars by 80% (Goh et al. 1982). Acidification of methanol did not greatly affect sinapine removal (Tab.1).

The four-stage countercurrent extraction at solvent to meal ratio of 6:1 decreased sinapine content by 86.4% while five- and six-stage extraction gave sinapine reduction of 93.5% and 96.4%, respectively (Tab.2). In this process

only 60 cm^3 of fresh solvent mixture was essential to reach this low level of sinapine. Using solvent to meal ratio of 10:1, 96.0% of sinapine reduction was already achived in four-stage extraction. The five-stage extraction lowered

Table 1. The efficiency of various solvents used in batch extraction on removal of sinapine from rapeseed meal

Extraction: 2x30 min solvent/meal 5:1	Protein meal Yield DM %	Protein (Nx6.25) %	Sinapine Content %	Sinapine Residual %
Initial meal	100	40.1	1.69	100.0
Water	69	39.7	0.61	36.1
70% ethanol	81	41.7	0.44	26.0
Aceton-methanol-water	80	42.9	0.34	20.1
Methanol-ammonia water	73	40.6	0.17	10.0
Methanol, pH 2.0			0.35	20.7
3.0			0.41	24.3
4.0			0.43	25.4
6.3			0.44	26.0

Table 2. The influence of countercurrent extraction conditions on sinapine removal from rapeseed meal

No of extraction	Solvent to meal ratio (v/w)	Protein meal Yield DM %	Protein (Nx6.25) %	Sinapine Content %	Sinapine Residual %
Initial meal		100	40.1	1.69	100.0
4	6	81	40.7	0.23	13.6
5	6	79	42.5	0.11	6.5
6	6	76	42.7	0.06	3.6
4	10	79	41.3	0.10	5.9
5	10	78	42.0	0.08	4.7
6	10	75	42.9	0.05	3.0

further sinapine level, however, rate of sinapine decreasing was lower than observed when solvent to meal ratio of 6:1 was used (Tab.2).

CONCLUSION

Low-sinapine protein meal with residual sinapine content below 0.1% compared to 1.7% in initial meal, can be obtained in either batch or countercurrent extraction. However, further study is necessary to increase yield of the product and its protein content. Preparation of such meal can only be considered if specific application of low-sinapine product is found.

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