INACTIVATION OF THE ENZYME MYROSINASE IN WHOLE RAPESEEDS

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Total inactivation of the enzyme myrosinase during the technological processing of rapeseeds is achieved only at the stage of meal toasting /1/. In most processes before toasting, there are conditions for hydrolytic decomposition of glucosinolates, so that their derivatives either remain in the meal or pass into oil. In order to prevent these processes, methods are being seeked for efficient destruction of the enzyme in whole rapeseeds, still before their flaking. The following methods of myrosinase inactivation were used in the present studies: irradiation, microwave heating and heat treatment of seeds in fluid layer. Effectivity of the methods used was estimated determining myrosinase activity, amount of decomposed glucosinates, sulphur content in oil, and nutritive value of rapeseeds flours.

MATERIAL AND METHODS

Rapeseeds of Skzeszowicki variety, harvested in 1982, were used. The seeds were moistened to reach moisture content 11.7% before irradiation, and 10% before microwave heating.

Irradiation was performed in a radiation chamber, provided with a source of gamma 60 Co rays, of total activity 20 KCi / 74 x 10^4 GBg/. Samples were irradiated at room temperature, in the presence of air oxygen, radiation doses being: 30,60, 1 x 10^3,2 x 10^3,2.5 x 10^3, 3.5 x 10^3,5 x 10^3 and 10 x 10^3 Krad. After irradiation, the samples were dried in room temperature.

Microwave heating of the seeds was carried out in a dryer. Seeds were placed in glass cells in a 1 cm thick layer and exposed to microwaves with frequency 2450 MHz for 1, 1.5, 2.5 and 3.5 min.

Hydrothermic inactivation of myrosinase in rapeseeds suspended in water vapour in fluidal layer was performed in a device constructed according to a Swedish patent /2/. Seeds remained in the chamber for 1 - 7 min. in temperature 106 and 110°C.

Myrosinase activity was determined with the method presented by Henderson et al. /3/. Amount of ITC and OZT was determined according to Youngs and Wetter /4/. Sulphur content in oil was determined according to Babuchowski and Zadernoswski /5/. Nutritive value of selected rapeseed flours was assessed on the basis of amino acid composition /6/.

RESULTS

Applied doses of gamma radiation resulted in a decrease of myrosinase activity within the range of 6.5. - 44.6% activity of the enzyme decreasing along with increasing radiation dose /Fig. 1 A/. The highest dose of 10×10^3 Krad resulted in only 45% decrease of myrosinase activity. It is assumed that total inactivation of the enzymes in food stuffs would necessitate even higher doses of gamma radiation, 10×10^3 - 40×10^3 Krad /7/. Such doses cannot be used in practice as they might cause considerable chemical changes in the food stuffs, or even make them toxic /8/.

Glucosinolate levels decreased along with increasing dose of gamma radiation /Fig. 1 A/, and amounted to 67% of the initial level in the sample which received the highest dose of radiation. This suggests that gamma radiation causes decomposition of glucosinolates and formation of their derivatives. Character of glucosinolate decomposition is not totally clear, it might be of enzymatic character, although possibility of a contact between myrosinase and glucosinolates in cells with destroyed structure cannot be excluded.

Oil extracted from irradiated seeds contained increased concentration of sulphur. Its level in the sample which received the highest dose of radiation was almost five times higher than in the control /Fig. 1 B/.

FIG 1 CHANGES OF MYROSINASE ACTIVITY AND GLUCOSINOLATE LEVELS IN MEAL /A/ AND OF SULPHUR CONTENT IN OIL /B/ UNDER THE EFFECT OF IRRADIATION OF WHOLE RAPESEEDS

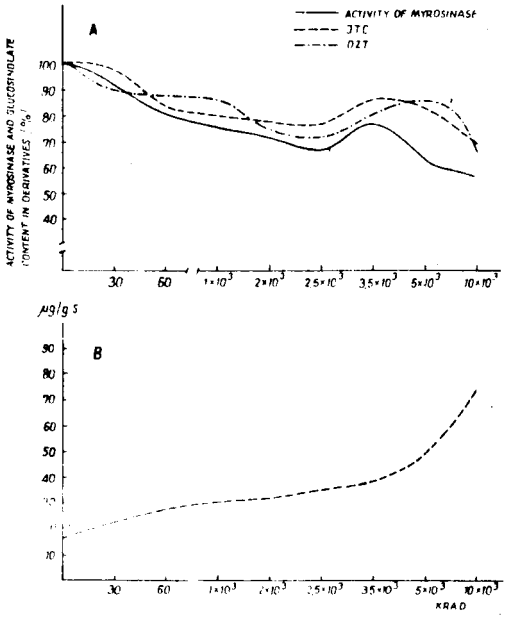
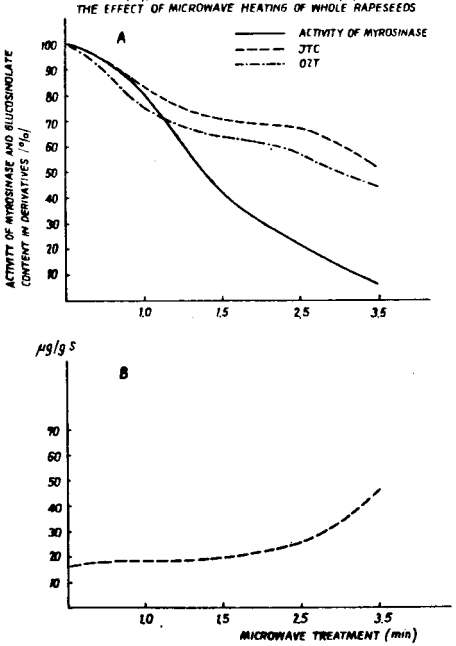


FIG 2 CHANGES OF MYROSINASE ACTIVITY AND GLUCOSINOLATE LEVELS IN MEAL /A/ AND OF SULPHUR CONTENT IN OIL /B/ UNDER THE EFFECT OF MICROWAVE HEATING OF WHOLE RAPESEEDS



Microwave heating

Microwave heating gave better results as regards inactivation of myrosinase than irradiation. Myrosinase activity decreased along with prolonging time of heating. 3.5 min. exposition resulted in 90% reduction of the enzyme activity /Fig. 2 A/. Glucosinolate levels in the sample also decreased, suggesting their thermal degradation during microwave heating. Sulphur content in the oil confirm these results /Fig. 2 B/. Similar results were obtained also by Maheshwari et al. /10/ who used microwave heating for inactivation of myrosinase in rapeseeds without hulls.

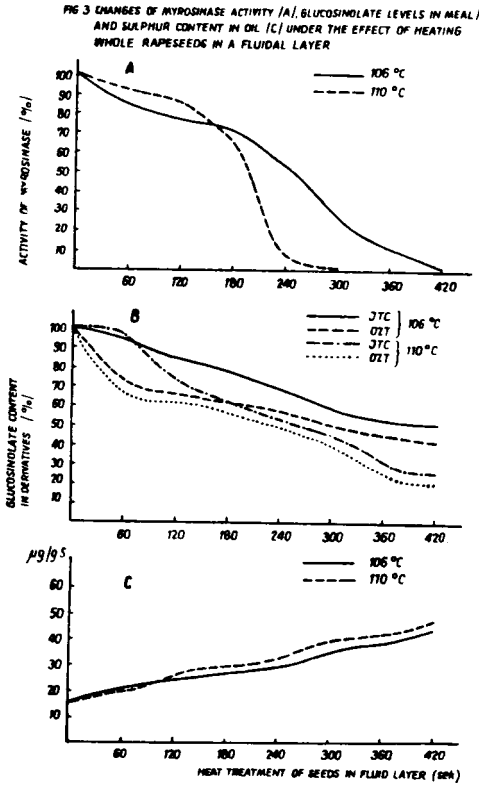


FIG 3 CHANGES OF MYROSINASE ACTIVITY /A/, GLUCOSINOLATE LEVELS IN MEAL /B/, AND SULPHUR CONTENT IN OIL /C/ UNDER THE EFFECT OF HEATING WHOLE RAPESEEDS IN A FLUIDAL LAYER

Heating in a fluidal layer

Seed heating in a fluidal layer resulted in total inactivation of myrosinase after 7 min. in 106°C or after 5 min. in 110°C/Fig. 3 A/.

Glucosinolate levels in the samples decreased along with prolonging time of heating /Fig. 3 B/. In seeds heated for 7 min. in 106°C content of glucosinolates decreased by half. Heating in 110°C resulted in even stronger decrease of glucosinolate levels, by 75% during 7 min.

Increasing content of sulphur in the oil reflected progressing decomposition of glucosinolates in rapeseeds heated in a fluidal layer /Fig. 3 C/.

Nutritive value determined on the basis of amino acid composition in selected samples revealed slight changes in the content of some exogenous amino acids under the effect of gamma radiation, microwave and fluidal heating /Tab. 1/.

Table-1 : Changes of essential amino acids after irradiation, microwave and fluid layer heating.

Sample	Phe	His	Ile	Leu	Lys	Met	Thr	Val	Trp
Untreated	4,0	2,2	3,5	6,9	6,4	2,2	4,0	4,6	1,2
Irradiated 10×10^3 Krad	4,0	1,4	3,6	6,4	5,4	2,1	3,8	4,7	1,1
Microwave heating 3.5 min.	4,1	3,2	3,7	7,2	6,2	2,1	4,4	5,2	1,2
Fluidal heating at 110°C	3,9	1,2	3,4	6,4	5,2	2,2	3,7	4,5	1,2

LITERATURE

1. Kozlowska H., H. Nowak, R. Zadernowski, R. Szulc, R. Cichon, 1977, Przemysk Spozywczy XXXI, 436.
2. Patent, Sweden, 1975, nr 23/3224, Dahlen JA Govde.
3. Henderson H.M., Mc Ewen T.J., 1972, Phytochem., 11, 3127.
4. Youngs C.G., Wetter L.R., 1969, J. Am. Oil Chem. Soc., 44, 551.
5. Babuchowski K., R. Zadernoswki, 1970, Tluszcze jadalne, 14, 140.
6. Hirst S.H., W.H. Stein, S. Moore, 1954, J. Biol. Chem., 211, 914.
7. Srenivalson A., 1972, Postepy Techniki Jadrowej, 16, 1509.

8. Schubert J., Proceedings of a Symposium, Wageningen, 1977.
9. Matile P.H., 1980, Biochem. Physiol. Pflanzen, 175, 722.
10. Maheshwari P.N., D.W. Stanley, F.R. Van de Woort, 1980, J. Am. Oil Chem. Soc., 57, 194.