

## PHYSICAL PROPERTIES OF CORN - OAT BRAN SNACKS\*

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**A b s t r a c t.** Studies have been undertaken in order to evaluate the usage of oat bran as a component in the production of cereal snacks. It was found that the mixture of corn semolina and bran components is a valuable raw material for extrudate production.

**K e y w o r d s:** extrusion - cooking, cereals, oat bran, physical properties

### INTRODUCTION

For many years oat products were consumed as hot meal in porridge or as ingredients in baked foods. Oat protein was generally recognised as very nutritious. At present, oat products are also well known as containing high quality dietary fibre, especially soluble fibre. Traditionally only the whole oat groats was used in human food. Recently grain fractions such as bran have been introduced as food product of high nutritive value since nutritional and clinical studies confirmed its role

in stabilising blood glucose levels and lowering serum cholesterol levels in the group of patients with high risk. Oat bran not only decreases total cholesterol, but also decreases LDL cholesterol level and increases HDL cholesterol level [1]. Considering the above, studies have been undertaken in order to evaluate the usage of oat bran as a component in the production of cereal snacks.

### MATERIALS AND METHODS

The mixture of corn semolina with oat bran inclusion at the level of 3, 6, 9, 12, 15, 18, and 21%, with grinding ratio as in Table 1, was extruded in a single screw extrusion-cooker S-45 (L:D=12:1, compression ratio of 3:1). Influence of mixture composition, material moisture level, die diameter, speed of the screw, and barrel temperature on the course of

**T a b l e 1.** Sieve analysis of components

Fraction (mm)	Corn semolina (%)	Oats meal (%)	Oats bran (%)
>1.6	0	2.40	3.74
1.6-1.2	0.12	12.86	11.64
1.2-1.0	6.40	12.94	16.20
1.0-0.8	27.76	16.38	23.22
0.8-0.5	43.54	22.96	26.32
0.5-0.265	17.02	12.88	10.26
<0.265	4.76	19.26	8.62
Σ of fractions <0.5	21.28	32.14	18.88

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the process, physical properties and chemical changes of the extrudate were examined. Oat bran was also extruded in a twin screw extruder 2S 9/5. The influence of process temperature, moisture content of the material, and die diameter on the course of the process, physical properties and chemical changes in the extrudate were the main subject of the research. Addition of whole milk powder at the level of 0.5% and 1% on physical properties and quality of the extrudate was also analysed. Expansion ratio was determined as the relation between the extrudate cross section area and the die cross section area. Structural components were determined by means of the method by Goering *et al.* [2]. Specific density of the extrudate was established in relation to its inner pores according to the method described by Rzedzicki [6]. Water absorption index (WAI) was determined by means of the method by Jao *et al.* [3]. Texture was determined as the amount of energy used for the destruction of a 1 g sample [5]. Lipid extraction was carried out by means of hexane.

## RESULTS AND DISCUSSION

Extruded trials with the use oat components as supplements for corn semolina were very successful, even with application of single screw extrusion - cooker. The extrusion process of the corn-oat mixture ran very smoothly. Up to 18% of oat bran and 21% of oat meal can be included in the corn semolina. With higher inclusion levels material sliding and disturbed conditions of extrusion were observed. Decrease in the extruder efficiency with higher inclusion of oat components was surprising (Fig. 1). A reverse tendency was expected due to high fat content.

Inclusion of bran components resulted in a slight decrease in radial expanding (Fig. 2). However, it was not accompanied by the equal decrease in the specific density (Fig. 3). In the case of one sample only density of above 70 kg/m<sup>3</sup> was noted. The above parameters had very good levels for this type of products and they were very favourably evaluated in the organoleptic tests. Additional application of milk

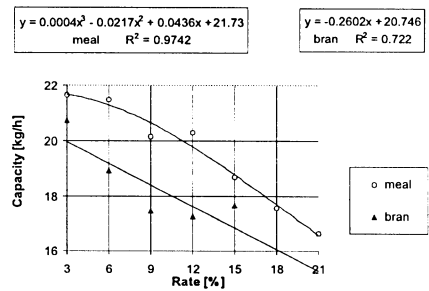


Fig. 1. Influence of oat components on the extruder efficiency.

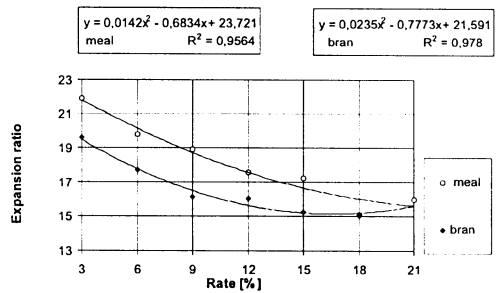


Fig. 2. Influence of the rate of oat components on the extrudate radial expansion.

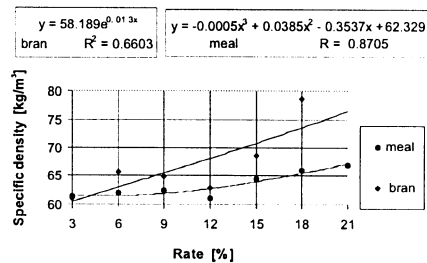


Fig. 3. Influence of oat components inclusion on the extrudate specific density.

powder was tested. Rate of whole milk powder in the oat bran and oat meal trials was 0.5% and 1%, respectively. Lower milk rate in bran trials was applied because of higher fat content in that component. Milk powder as a component for extrudate production could be successfully applied. Small rate of milk could improve expansion ratio and specific density as well (Figs 4 and 5).

An inclusion of oat components changed extrudate texture only very slightly. With an

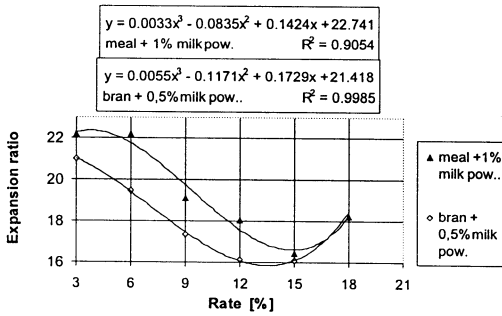


Fig. 4. Influence of the rate of oat components and milk powder on the extrudate radial expansion.

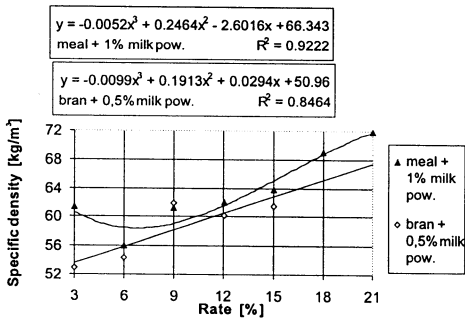


Fig. 5. Influence of oat components and milk powder inclusion on the extrudate specific density.

increase in both meal and bran content a slight increase in destruction energy was noted. However, it did not exceed the level of 0.33 J/g (Fig. 6). It was a very good parameter for corn crisps and was very highly evaluated in the organoleptic tests.

A small inclusion of powdered milk, i.e., 0.5 and 1% changed the structure only to a very small degree (Fig. 7). In the case of samples with the inclusion of oat bran a very high value of the coefficient of determination was observed.

A small inclusion of powdered milk of 0.5% not only built the structure. Whole milk powder contains about 38% of lactose and due to Maillard reaction is an excellent marker of product overheating and allowed for proper choice of process parameters.

The extruded products with the inclusion of oat components have very high water absorptivity. It ranged from 270 to 330% (Fig. 8).

It was not possible to obtain high quality products on the single screw extrusion - cooker using only oat components. Material

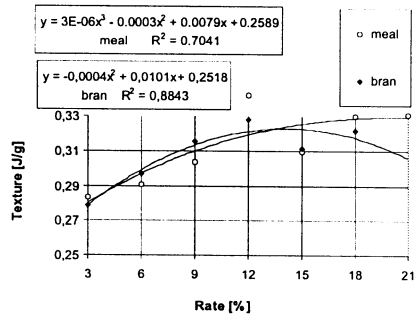


Fig. 6. Influence of oat components inclusion on the extrudate texture.

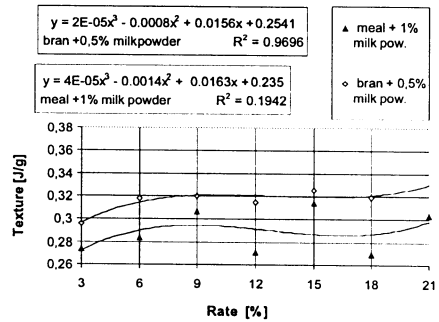


Fig. 7. Influence of powdered milk rate on the texture of extrudates with oat components.

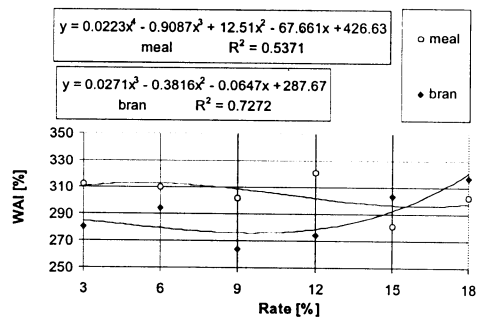


Fig. 8. Relation between water absorptivity and rate level of oat meal and bran.

sliding and unstable run of equipment was observed. The produce obtained could not be called "full" extrudate as it was not obtained in stable working conditions. This type of process run is conditioned by high fat content and specific features of oat starch. The problem requires further studies since some of the components with higher fat content extruded very well. The seeds of white lupine contain up to 9% fat and still extrude very well on the single screw extruder [4].

It was not possible to obtain high quality products with application only oat components on the twin screw extrusion - cooker 2S - 9/5 as well. Material sliding is not observed and stable run of the process occurs. The produce obtained could not be used for direct consumption, but it could be applied as a semiproduct in food industry. The problem requires further studies and probably application of extrusion - cookers with higher L:D will be necessary.

Oat extrudates obtained from a twin screw extruder were subjected to examination of chemical changes. Similarly to lupine extrudates [7] a decrease in the content of fat extracted by the non-polar solvent was noted (Fig. 9). Higher fat binding was noted with the increase in the raw material moisture level and lowering of process temperature.

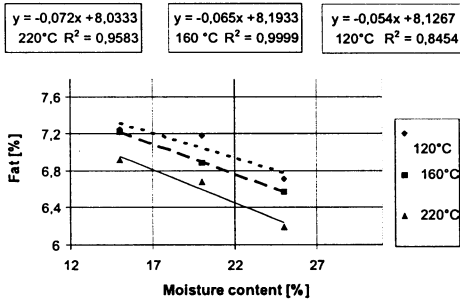


Fig. 9. Influence of parameters of the extrusion process on the fat extractability in oat extrudates.

The extrusion process influenced the content of structural components. With an increase in the process temperature an increase in the content of raw fibre was observed (Fig. 10). Similar tendencies were observed for the acidic-detergent lignin. In the case of ADL an additional increase in the content of this fraction was observed with the increase in the raw material moisture content. Hence, in the case of this material an increase in the moisture content was accompanied by the increased fat binding and increase in the content of ADL fraction (Fig. 11).

The observed intensification of transformations in crude fibre and ADL lignin pointed to the fact, that process parameters should be

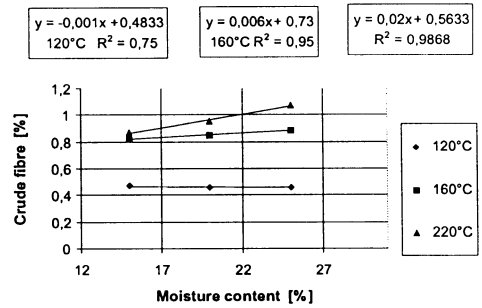


Fig. 10. Influence of parameters of the extrusion process on the content of raw fibre in oat extrudates.

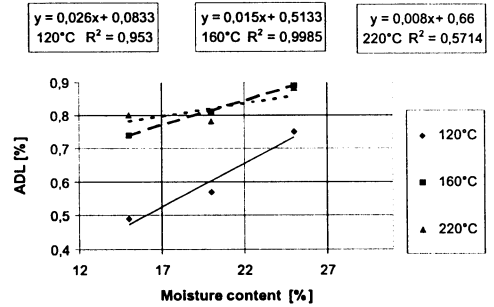


Fig. 11. Changes in the ADL fraction content in oat extrudates.

carefully selected not only to reach excellent physical properties but also due to high risk of poorer product quality.

## CONCLUSIONS

1. The mixture of corn semolina and bran components is a valuable raw material for extrudate production.
2. Inclusion of oat bran can reach the level of up to 18%, and oat middlings up to 21%.
3. Inclusion of oat components did not result in the worsening of radial expansion, proper density or the texture of the produce.
4. Oat bran can be successfully used in the mixtures with other raw materials as texture modifiers.

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