FORMULA DEVELOPMENT OF A NEW NUTRITIONALLY MODIFIED READY TO SERVE MEAT PRODUCT

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INTRODUCTION

Ready to serve meat products can be produced with addition of many ingredients such as: vegetables, cereals, plant proteins and so on. The nutritional value of such products is higher due to vitaminsand minerals content. Hulls can be distinguished among above mentioned ingredients. Possibility of using soy hulls in meat products is investigated at University of Missouri - Columbia (6).
Collaboration studies but upon wheat hulls are in progress in Poland.
The studies upon this topic find justification from both economic and nutritional view point. A meat-cereal products can substitute similar meat products (e.g. hamburgers, meat balls) and balance the unbalanced meat market in Poland.
Crop seed hulls which are considered the least valuable of seeds are known as by-product in the seed processing plant. Until recently they were used in animal feeding only. The nutritional value of hulls is due to their chemical composition as well as due to digestion and bioavailability of certain amino acids. Hulls represent a mixture composed of seed coat pieces, aleuronic layer, bud seeds and of flour endosperm present in inconsiderable amount.
In Poland wheat hulls are processed and available for human consumption.
The percentage of hulls varies somewhat with the size of the seed and is about 10% of seed weight. Wheat hulls contain up to 14% water, 5-8% ash, 5-10% crude fiber, 3-4% fat, 11-18% protein and 4-20% starch (1,4). Due to the high content of lysine, which in the crop seed limits the bioavailability of seed protein, hull protein has the higher bioavailability. PER value for hull protein is usually 2-4 times higher than for the flour protein (4). Hulls are a good source of several mineral compounds (calcium, sodium, copper, potassium, phosphorus, zinc, iron, manganese, magnesium, cobalt), they contain vitamins mainly from B group (thiamine, riboflavin,niacin). Among carbohydrates the essential group are the ballast substances (fiber), which account for 80% of total carbohydrates content. Ballast substances are complicated group of polysaccharides composed of hemicellulose, cellulose, lignin. Especially high content of hemicellulose (insoluble form) should be underlined, that distinguish the hulls among other carriers of ballast substances (3, 5).
The influence of fiber on the digestion processes is reported through increased intestinal tract persistalsis. It was reported that low content of fiber in the diet causes some arteriosclerosis and (alimentary canal diseases 2,3).
The study can be considered as the first part of the project leading towards developing, processing and marketing of a meat product that contains a certain amount of fiber in the form of wheat hulls. The entire process, from ingredient selection, nutrient and sensory analysis and refrigerated storage stability, was investigated in the study. The purpose of the study was to develop formula and preparation

processes and to estimate the influence of holding in a frozen state on the product quality.

MATERIALS AND METHODS

The formula was prepared and than processed according to the schedule shown on fig.1. Ground beef and pork were used in relation 3:2, 1:1, 2:3 by weight. Ground processed wheat hulls were added in amount 10, 15, 20% of meat weight. Two heating processes frying and baking were studied. The product quality was based on chemical analysis (content of water, fat, protein, ash and carbohydrates), phyisico-chemical properties (texture, color, ph) and sensory analysis (taste, smell, texture, consumer preference).
Accepted laboratory procedures were used for chemical analysis. Penetrometer "Labor" was used for texture determination. The level of penetration read from the scale described the consistency of the product. (1 degree of penetration equals penetration of 0.6 mm under the force of 100 G during 5 s period).
Tristimulus photocolorimeter "Momcolor D" (made in Hungary) was employed for color determination. The dominant wave (λd), colorimetric purity (p) and brightness (Y) were determined.
The sensory analysis included five point evaluation of individual properties (taste, smell, color, texture) and consumer evaluation according to the preferation scale.
Products were hold in a frozen state (t= -18oC) for 4 and 8 weeks. The sensory analysis of restored products (10 min. heating at 220 oC in a conventional oven) were done after each holding period.

RESULTS

The preliminary study revealed that the maximum content of wheat hulls should not exceed 20% of the meat weight. Higher levels of hulls were not accepted by the consumers.
The technological process was developed (fig. 1) and than analyzed while the amount of hulls, beef/pork meat proportion, and heat processing methods varied. If the levels of hulls and beef meat increased in the formula, than water and fat content decreased in the product. It was due to the fact that both hulls and beef meat contain small amount of above ingredients (tab.1). At the same the protein content increased what is considered a positive occurrence from the nutritional view point.
The increased level of carbohydrates from the hulls was stated, as well; they are mainly egested from the organism and fiber hydration causes the gel matrix appearance that increase digestion processes (3).
Sensory analysis comparison among the pure meat and meat product has shown , that 10% and 15% addition of hulls did not cause any significant deference in sensory scores. The various heat treatments did not influence taste, smell and texture of the product regardless of its composition.
The study revealed the best product is achieved when beef - pork proportion is 1:1.
Addition of hulls together with beef meat significantly influenced the color of the product. It was stated that increased level of beef causes the color darkening (higher value λd), while the addition of hulls paleing of the product (lower value λd) (tab.3).
Both sensory and instrumental analysis revealed increased hardness of product with wheat hulls (tab.3). The influance of frozen storage on the sensory quality of meat-cereal products. The sensory scores differed significantly only for products with 0 and 20% hulls content. Taking into account the beef and

hulls levels and storage periods, it should be concluded ,that addition of hulls and increased levels of beef have the positive influence on taste, smell and texture of the product. (fig.2).

Conclusions

The studies proved that basing on the chemical composition, energetic value and on sensory analysis conducted prior and after storage in a frozen state, the following conclusion can be drown:
the highest consumer acceptance on the market would have the product with following ingredient composition:
beef meat 37.7%,
pork meat 37.7%,
wheat hulls 7.5%,
salt 0.8%,
seasonings 0.6%,
milk 2% 11.2%,
onion 4.5%.
The addition of hulls have positive influance on the product texture.
As far as the taste is concerned products with 10% and sometimes with 15% of hulls are similar to pure meat products.Freezing and storage at - 18 oC for 8 weeks, did not cause any sensory changes in meat-cereal products, while the quality of pure meat products was lowered.
The research is continued in the fields of formula modification (finer grinding and solubility), energy analysis of various ways of processing, storage and restitution, microbial quality and phisico-chemical and nutritional analysis of new products.

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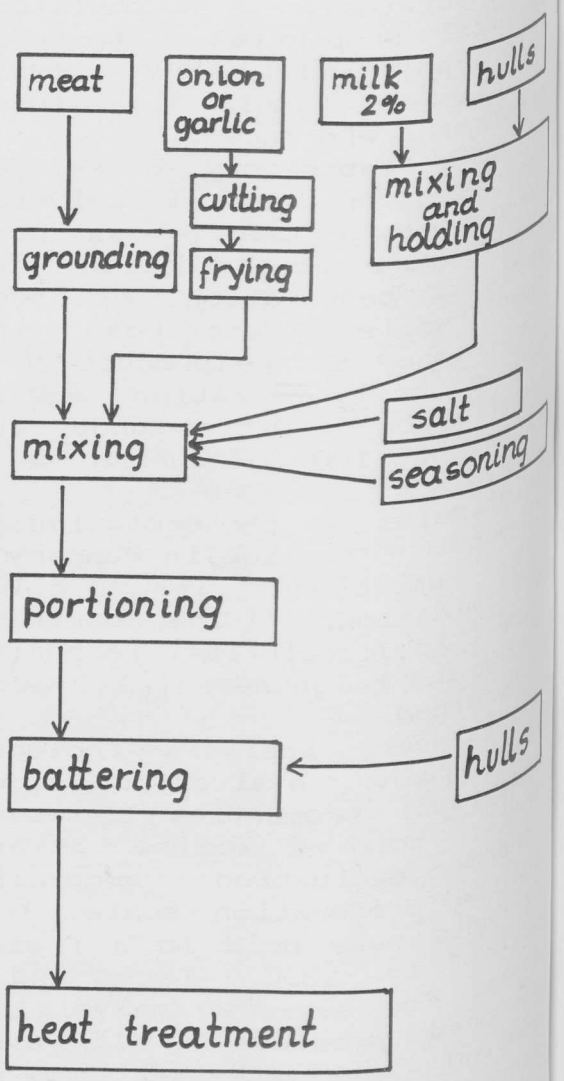
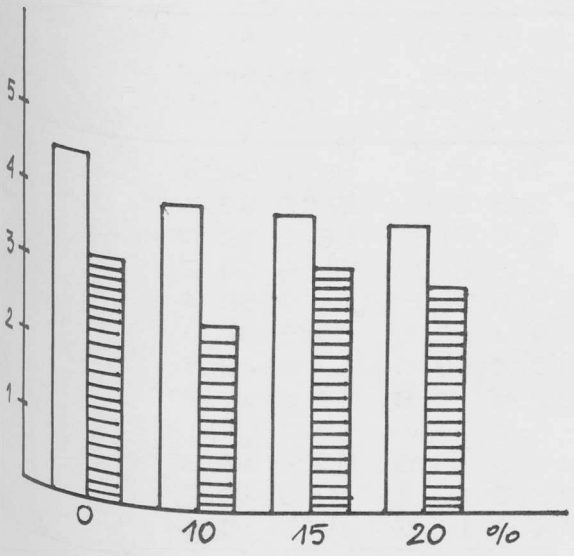
Fig.1.Formula processing diagra

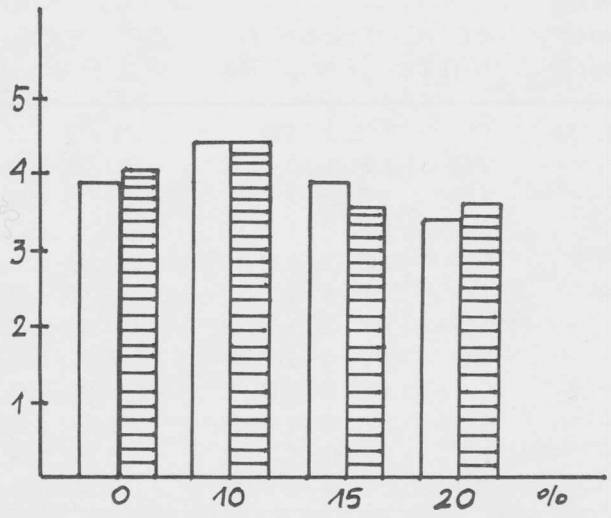


A. Proportion beef:pork - 2:3



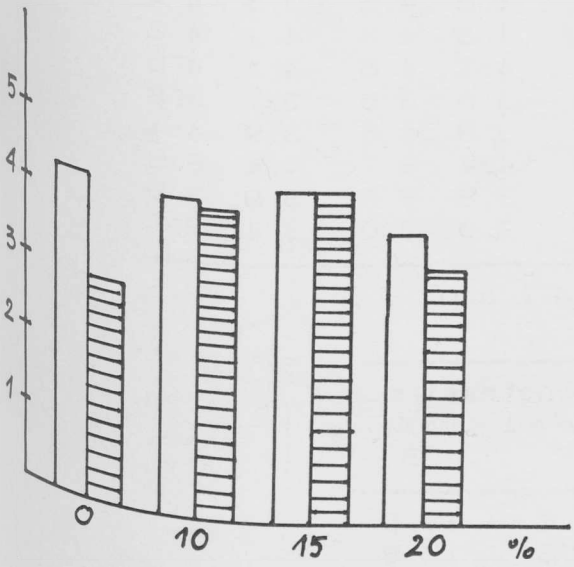
addition of hulls

C. Proportion beef:pork - 3:2



addition of hulls

B. Proportion beef:pork - 1:1



addition of hulls

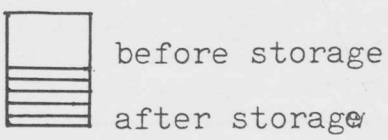


Fig.2. Sensory scores of fried products, prior and after freezing storage.

tab 1. Chemical composition of new products

Prop. beef/ pork	% of hulls	Content (%) Protein F*	Protein B*	Fat F	Fat B	Carboh. F	Carboh. B	Water F	Water B	Ash F	Ash B
2:3	0	16.1	16.1	21.9	22.2	4.9	5.2	55.1	54.4	2.0	2.1
	10	17.1	17.2	20.8	20.8	5.8	6.0	52.9	53.5	3.2	3.3
	15	17.2	17.1	20.8	20.4	6.9	7.2	52.2	52.0	3.3	3.3
	20	17.2	17.3	20.1	20.1	8.2	8.2	51.9	50.2	3.6	3.6
1:1	0	16.5	16.6	21.2	21.2	5.5	7.8	54.9	52.4	2.0	2.0
	10	17.1	17.1	17.4	17.5	9.4	10.8	53.5	51.3	3.1	3.2
	15	17.3	17.3	17.2	17.3	10.4	13.6	48.9	48.7	3.2	3.2
	20	17.4	17.3	17.1	17.1	12.5	14.8	49.5	41.3	3.5	3.6
3:2	0	16.9	16.7	21.9	20.7	6.4	9.4	52.7	51.1	2.1	2.1
	10	17.0	17.2	18.7	18.4	10.5	13.6	50.8	47.8	2.9	3.0
	15	17.2	17.2	18.0	18.3	12.5	13.4	49.0	47.7	3.3	3.5
	20	17.4	17.5	18.1	18.1	14.3	14.5	46.7	46.4	3.5	3.5

tab. 2 Five point sensory analysis

Prop. beef/ pork	% of hulls	Texture F	Texture B	Flavor F	Flavor B	Taste F	Taste B	Total F	Total B
2:3	0	4.2	4.7	4.7	4.7	4.3	4.5	4.4	4.6
	10	4.0	3.8	4.3	4.1	3.7	3.5	4.0	3.8
	15	4.0	4.0	4.3	4.7	3.6	3.6	3.9	4.1
	20	3.8	3.3	4.2	3.6	3.5	3.0	3.8	3.3
1:1	0	4.2	4.2	4.4	4.2	4.5	4.6	4.4	4.4
	10	4.4	4.1	4.0	4.1	4.2	4.3	4.2	4.2
	15	4.2	4.3	4.3	4.6	4.7	4.6	4.4	4.5
	20	3.8	3.7	3.9	4.2	3.6	3.6	3.7	3.8
3:2	0	3.5	4.0	4.3	4.7	3.8	4.6	3.9	4.4
	10	4.4	3.1	4.4	3.8	4.4	3.7	4.4	3.5
	15	4.1	3.8	3.8	4.4	3.8	3.6	3.9	3.9
	20	3.7	3.1	3.4	3.6	3.0	3.0	3.4	3.2

tab. 3. Color (dominant wave-lenght λd) and texture of new products

Prop. pork/ beef	% of hulls	λd (nm) F	λd (nm) B	Penetration level (mm) F	Penetration level (mm) B
2:3	0	590	593	17.4	18.0
	10	588	589	16.2	16.8
	15	581	584	15.6	16.2
	20	579	582	15.0	15.6
1:1	0	611	607	22.8	23.4
	10	608	597	22.8	21.6
	15	597	585	16.8	20.4
	20	590	581	15.0	18.6
3:2	0	592	603	24.0	24.6
	10	588	590	23.4	22.8
	15	585	588	17.4	21.0
	20	584	588	15.0	18.6

* F - fried, B - baked,