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EXTRUDED FISH WEED AND OLD BREAD AS QUALITY AND SAFE PROTEIN FEED

Abstract: *This paper describes the technological process of extrusion of fish weed and old bread mixed with soybean and corn grits in order to obtain high-quality protein feedstuff for animals. Chemical analysis showed a high content of crude protein, crude fiber, minerals and the significant presence of phosphorus and calcium. Moisture content was significantly reduced. Microbiological analysis showed significant reduction in the number of moulds and bacteria after extrusion compared to the raw material. This protein feedstuff justifies its production in terms of quality of the finished products, but also from an environmental and economic ground.*
Keywords: *quality, fish weed, old bread, extrusion, protein feedstuff*

1. INTRODUCTION

Deficiency of food for humans and animals is a problem in the world that is solved by using modern technology and biotechnology. The basic orientation is the new technological procedures that increase the nutritional value and valorization of waste products of food and primary agricultural production. Based on research of Vujković et al. (1993) share of "weed fish" in the total amount of fish that has been is caught up to 27.66%, depending on the method of fish farming[1].

These quantities are important for the processing in feedstuff. Inedible by-products from fish are a rich source of protein, mono- and polyunsaturated fatty acids, vitamins and minerals in a form convenient for the production of fish meal or protein feedstuff (Kormanjoš i sar., 1998) [2].

For consumers sensory properties make the quality of bread, while for the nutrition science its biological and nutritional value. In particular, the issue of bread quality is its health-safety status and the presence of harmful substances. On the basis of subjective impressions through the senses of smell, taste, sight, touch and hearing, leads to an objective assessment of quality of bread. In our country when the bread is left over night, it is dry and discarded. Estimate of the amount of discarded bread is done through surveys of consumers, small bakeries, large industrial bakeries, large chain stores, large restaurants, city utilities and through interviews with experts. In Serbia there are no statistics on the quantities of the remaining bread in the bakery, returned from the market and thrown bread. Based on the survey of the Institute for Food Technology in Novi Sad (FINS) that was made during the period January-March 2010, the amount of old bread is somewhere in between 5-10%.

Percentage of thrown bread in the European Union is about 1% and in England about 0.1%.

The study also found that from approximately one million of 500g loaves

that is produced in Vojvodina, at least 50,000 loaves are discarded, which is 25 tons of bread per day[3].

Depending on his health-safety status and the presence of harmful substances we have an extremely attractive raw material or a major problem. Appropriate technological procedures will be applied that are able to preserve the protein to the fullest extent possible, while the obtained product is hygienically safe and suitable for incorporation in compound feed.

Extrusion as a heat process is used to improve the nutritional, hygienic, physico-chemical and sensory properties, as well as for inactivation of possibly present thermo labile antinutrients (Jansen, 1991) [4].

Extrusion leads to a reduction in starch content due to its degradation to dextrin (Filipović et al., 2003). Processing of "fish weed" is primarily related to the solution of removing water and fat[5].

The investigation which was carried out by Ristić et al. (1997) showed that by drying on plant carrier obtained feedstuff satisfy most of the animal needs for amino acids[6]. This procedure is far simpler, more economical and environmentally justified than the removal of water and fat using special technological processes.

In this paper the extrusion process was conducted at a temperature of 90°C for the mixture with fish weeds to prevent degradation of thermo labile amino acids (cystine and cysteine), and at 95°C for the mixture with the old bread.

Mixture for extrusion was made of full-fat soybean grits (plant carrier), and grinded fish weed and old bread in mixture with corn grits.

2. MATERIALS AND METHODS

In feedstuff production with extrusion process we used a mixture of previously grinded fish weed from natural fish pond and full-fat soybean grits, pre-mixed in a ratio 1:2. First the raw material was grinded using a "cutter" - a machine for grinding, and then it was inserted in the counter flow mixer with full-fat soybean grits. In extrusion process of corn grits and bread crumbs we used corn grits with 12% moisture and bread crumbs mixed in a ratio 60:40 and 50:50 in counter flow mixer, and after that the moisture of mixture was increased to 18%.

Basic chemical composition was determined by AOAC (1984) [7]. Extrusion was carried out on extruder type E-250, manufactured in Ukraine, with a capacity of 1000 kg/h. Extruder was composed of four segments, with a head opening diameter of 10 mm and an electric motor installed capacity of 37 kW.

Total number of microorganisms, number of moulds, yeasts, isolation and identification of *Salmonella* and sulphite reducing Clostridia were determined in accordance with the Regulation on the Methods of Carrying out Microbiological Analyses and Super-analyses of Foodstuffs (1980) [8].

For determining presence of coagulase-positive staphylococci, *Proteus* species and *Escherichia coli* an internal laboratory method was applied, as follows: Pour 50 ml of test sample into Erlenmeyer flask containing 450 ml of sterile nutrient broth. Homogenize sample and incubate at 37^0C for 24 h.

Perform isolation and identification as specified in the Regulation on the Methods of Carrying out Microbiological Analyses and Super-analyses of Foodstuffs.

3. RESULTS AND DISCUSION

Results of chemical and microbiological analysis of "fish weed" are given in Tables 1 and 2.

Chemical composition indicated high water content of 73.14%, and in dry matter high content of protein (53.06%), fat (27.80%) and minerals (10.75%). Furthermore, microbiological analysis

showed that this material with 20 million bacteria and 5000 moulds is not safe to use.

Table 1. Chemical composition (%) in "fish weed"

Moisture	73.14	on DM basis
Crude protein	14.41	53.06
Crude fat	7.55	27.80
Ash	2.92	10.75
N-free extract	0.95	3.50
Phosphorus	0.35	1.29
Calcium	0.98	3.61

Table 2. Microbiological analysis of "fish weed"

Microorganisms	Number in	Number
Salmonella sp.	50g	0
Coagulase-positive staphylococci	50g	0
Sulphite reducing Clostridia	1g	0
Proteus sp.	50g	0
Escherichia coli	50g	0
Total number of moulds	1g	5,000
Total number of yeasts	1g	0
Total number of bacteria	1g	20,000,000

Results of analysis of extruded mixture of fish weed and soybean grits are given in table 3 and 4. Chemical composition and microbiological analysis of extruded mixture were determined.
Using extrusion treatment on a mixture of fish weed and soybean grits we obtained high-energy, protein feedstuff that is hygienically safe with only 70,100 bacteria and 300 moulds in 1g. This product can be used directly in animal feed production. In order to safely store it in long term it is necessary to lower the moisture to 13%, and drying procedure should be performed at temperatures up to 70°C in order to preserve the vitamins and other nutrients.

Table 3. Chemical composition (%) of extruded mixtures of "fish weed" and soybean grits

Moisture	21.28	on DM basis
Crude protein	32.57	41.37
Crude fat	16.87	21.43
Crude fiber	6.53	8.30
Minerals	4.90	6.22
N-free extract	16.70	21.21
Phosphorus	0.37	0.47
Calcium	0.78	0.99

Table 4. Microbiological analysis of extruded mixtures of "fish weed" and soybean grits

Microorganisms	Number in	Number
Salmonella sp.	50g	0
Coagulase-positive staphylococci	50g	0
Sulphite reducing Clostridia	1g	10
Proteus sp.	50g	0
Escherichia coli	50g	0
Total number of moulds	1g	300
Total number of yeasts	1g	0
Total number of bacteria	1g	70,100

Table 5. shows the chemical and granulometric composition of corn grits, which indicates that this is energy protein feedstuff with 1544 KJ/100g and 75.23% starch, 6.88% protein and 1.14% fat. Granulometric composition shows that only 9.8% of particles are above 550 μm, and 81% above 250 μm, which makes this

feedstuff fine granulated, with a bulk density of 654 kg/m^3.

Table 5. Chemical and granulometric composition of corn grits

Quality parameters	Content (%)
Moisture	13.36
Crude ash	0.24
Crude protein	6.88
Total sugar	2.23
Total reducing sugars	0.49
Starch	75.23
Fat	1.14
Energy value	kJ/100 g
Energy value determined with calorimeter	1544
Granulometric composition	Content (%)
Proportion of particles above 550 μm	9.8
Proportion of particles above 250 μm	81
Proportion of particles below 63 μm	9.2
Bulk density (kg/m^3)	654 kg/m^3

Table 6. *Microbiological analysis of corn grits*

Microorganisms	Dilution	Number
Salmonella spp.	in 50g	-[a]
Coagulase-positive staphylococci	in 50g	-
Sulphite reducing Clostridia	in 1g	-
Proteus species	in 50g	-
Escherichia coli	in 50g	-
Total number of yeasts	in 1g	-
Total number of moulds	in 1g	80
Total number of microorganisms	in 1g	500

a- was not detected

Table 7. Chemical and granulometric composition of bread crumbs

Quality parameters	Content (%)
Moisture	12.87
Crude ash	2.24
Crude protein	11.44
Total sugar	2.72
Total reducing sugars	2.08
Starch	63.34
Fat	3.18
Energy value	kJ/100 g
Energy value determined with calorimeter	1589
Granulometric composition	Content (%)
Proportion of particles above 550 μm	45.6
Proportion of particles above 250 μm	40.2
Proportion of particles below 63 μm	14.2
Bulk density (kg/m^3)	415 kg/m^3

Table 6. *Salmonella sp.*, coagulase-positive staphylococci, sulphite reducing Clostridia, Proteus species, *Escherichia coli* and yeasts were not found in corn grits, while 80 moulds and 500 microorganisms were found in 1g of sample.

Table 7. Bread crumbs are food product obtained by subsequent processing of bread that has not been used. This product contains 63.34% of starch, 11.44% protein and 3.18% fat, with energy value of 1589 kJ/100 g, so this feedstuff is a high quality protein energy feedstuff in feed production industry. Results of microbiological analysis of bread crumbs are given in Table 8.

Obtained results show that bread crumbs are hygienically safe and that total number of moulds and microorganisms in 1g is 30.

Results of chemical analysis and bulk density of extruded mixture of bread crumbs and corn grits are given in Table 9.

Table 8. Microbiological analysis of bread crumbs

Microorganisms	Dilution	Number
Salmonella spp.	in 50g	-[a]
Coagulase-positive staphylococci	in 50g	-
Sulphite reducing Clostridia	in 1g	-
Proteus species	in 50g	-
Escherichia coli	in 50g	-
Total number of yeasts	in 1g	-
Total number of moulds	in 1g	30
Total number of microorganisms	in 1g	30

[a]- was not detected

Table 9. . Chemical and bulk density of extruded mixture of corn grits and bread crumbs

Quality parameters	Content (%)	
	Extruded mixture (corn grits : bread crumbs, 50:50)	Extruded mixture (corn grits : bread crumbs, 60:40)
Moisture	8.40	8.53
Crude ash	9.25	9.81
Crude protein	1.25	1.03
Total sugar	5.20	5.93
Total reducing sugars	3.46	3.40
Starch	69.8	65.36
Fat	2.64	2.12
Energy value	kJ/100 g	
Energy value determined with calorimeter	1635	1642
Bulk density (kg/m^3)	119 kg/m^3	92 kg/m^3

Obtained results indicate reduced moisture content compared to raw material, reduction of starch and increase in total and reducing sugars as a result of thermal decomposition of starch, which results in a change of starch digestibility and utilization. Increased sweetness i.e. changes in organoleptic properties is the result of physical and chemical changes in starch. Change is obvious in bulk density value of extrudates compared to raw material.

The results of microbial analysis show that in the extruded mixture of corn grits and bread crumbs extrusion process lead to a complete reduction of moulds despite the relatively low extrusion temperature (95-105ºC) and a very short extrusion time (6-10s) (in 1g of 50:50 mixture were present 40 microorganisms, and only 20 in mixture 60:40), as a consequence of very high extrusion pressure, which ranges from 30 to 40 bar [5]. *Salmonella sp.*, coagulase-positive staphylococci, sulphite reducing Clostridia, Proteus species and *Escherichia coli* were not found in extruded mixtures.

4. CONSULSION

High-energy protein feedstuff that is hygienically safe was obtained using extrusion process of mixture of "fish weed" and soybean grits. The content of moisture was 21.28%, 32.57% of protein, 16.87% of fat and 4.90% of minerals, also 0.78% of calcium and 0.4737 of phosphorus. Obtained product is nutritionally valuable and it can be used for the preparation of feed for all types and categories of animals. Based on the results it is necessary to use large quantities of old bread and with processing technologies to make high quality, health safety and economically valuable products of food for humans and animals. Without the knowledge our food industry is a major generator of waste that takes up significant and extremely valuable surfaces of suburban land and threatens waterways.

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