Possibility of Using Leftover Bread as Safe and Quality High-Quality Food and Feed

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Abstract: *Food production is a top priority issue, as the lack of food for the continuously growing population is becoming an increasing problem in the world and in Serbia as well. Increase of food production for humans and animals can be achieved by use of new technologies in biotechnology, i.e. in bio-industry. Nowadays, there are many different ways for thermal processing of cereals: toasting, extrusion, hydrothermal processing, micronization, microwave treatment, while in Serbia, most frequently used processes are extrusion and hydrothermal processing. Baking industry is highly developed in Serbia. Bread consumption per capita in Serbia is far above average consumption in EU. According to the survey conducted, there is a significant amount of leftover bread in Serbia. Leftover bread represents an environmental problem, but also potentially valuable raw material for human food and animal feed. The directions for use of leftover bread have been presented in this paper.*

Keywords: *leftover bread, health and safety food, environmental protection*

1. INTRODUCTION

Bread is the most frequent product made of grains and also basic food in many countries. It is made by mixing flour and water and certain secondary materials, which after fermentation, shaping and baking gives the final product. After taking them out of the oven, loaves have to be cooled down, over the time they become drier and their quality changes [1]. One of the habits of population in Serbia is to discard bread which is not consumed in one single day. This raises the question of quantity and quality of leftover bread and its safety for further use.

2. MATERIAL AND METHODS

The survey was conducted through questionnaires and interviews of consumers, small bakeries, large industrial bakeries, large retail chains, restaurants, city utility companies in the territory of Vojvodina. The research was conducted in the period from January to March 2010 by the Institute of Food Technology in Novi Sad (FINS). Statistical and computer processing of survey data was done using the software package "SMARTLINE", Novi Sad.

In order to avoid loss of information, finding the finest links and information on non-parametric sizes, the scaling of the data in contingency tables were applied. This process is based on the frequency so

each class was assigned with the real number. Statistical analysis included multi-analysis of variance (MANOVA), discriminative analysis, and other parametric procedures and methods. Also, Roy's test, Pearson's Contingency coefficient (c), and multiple correlation coefficient (R) were calculated.

3. RESULTS AND DISCUSION

There are no official statistical data on the quantities of leftover and discarded bread in Serbia, whereas in England it is about 0.1%. According to the survey carried out in January - March 2010 by the Institute for Food Technology in Novi Sad (FINS) the amount of leftover bread in Serbia ranges from 5-10% of the produced quantity. On basis of earlier researchies in FINS on Table 1 is shown chemical composition of different types of bread and bakery products. Key factors for the quality (attributes influencing the quality) of bakery products, according to the attitudes of consumers, are:

- Raw materials quality,
- Technology
- Sanitation and
- Baker's knowledge and experiance

Table 1. Chemical composition of different types of bread [4].

Product type	Flour		Chemical composition %						
	Rye	wheat	Water	Proteins	Fat	Carbohydrats	Cellulose	Ash	Bruto calories per 100 g product
Rye bread	Wholegrain	-	45.5	5.9	1.1	44.5	1.0	2.0	217
Pan bread	refined	-	42.0	6.2	0.8	49.0	0.5	1.6	233
Heart bread									
Wheat bread	-	Wholegrain	43.1	7.0	1.6	45.1	1.2	2.0	228
Loaf	-	Dark	35.8	9.0	1.3	51.4	0.7	1.8	260
Bun	-	Semiwhite	31.7	9.4	2.0	55.1	0.2	1.6	283
Fatly baked Ware	-	White	35.0	7.6	5.5	50.7	0.2	1.0	290
Toast rye	Wholegrain	-	11.0	11.4	1.4	70.6	1.9	3.7	349
butter	-	white	11.0	9.5	5.5	72.3	0.2	1.5	387
	-	semiwhite	17.0	10.6	1.2	69.0	0.2	2.0	338

It was found that from one million of 0.5 kg loaves produced in Vojvodina, a minimum of 50, 000 loaves are discarded what makes total of 25 tons of bread per day. From a safe of leftover bread, i.e. without the presence of harmful substances, a very attractive raw material can be obtained or a major health and environmental problems can be created. Mycotoxins from unsafe leftover bread pose a serious health threat for the part of population who collect food from street dustbins.

A significant amount of leftover bread comes from:

1. Households (it is thrown away together with other waste or in separate bags); Bread is 1-5 days stale and of problematic microbiological safety.
2. Large bakeries - undelivered products or products returned from supermarkets.
3. City dumps where large quantities of

bread ends up mixed with and contaminated by other waste. Small bakeries quite rationally and economically organize their production. Leftover bread is not a problem for them according to the survey carried out with small bakeries.

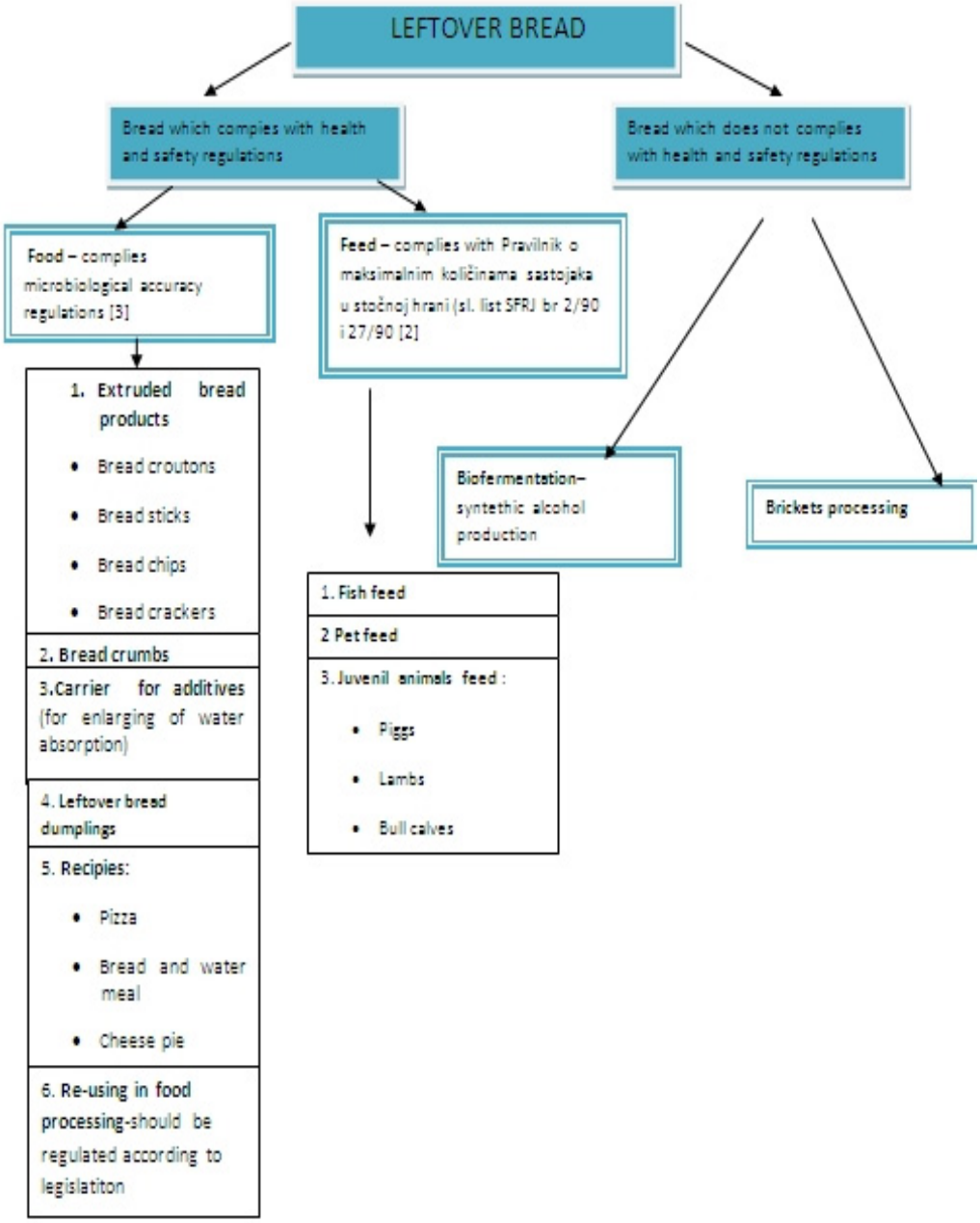

Figure 1. Posibbility of leftover bread processing and its re-use [4]

The basic requirement is to manufacture safe fresh bread, to make sure that leftover bread is harmless as a raw material for further processing. Special attention should be given to good hygiene practice, which is anyway compulsory for bakers. Implementation of HACCP improves the situation on the market, as those who do not fulfil hygienic requirements, will not be allowed to manufacture, wheras those who do, will have a regular quarterly check ups.

Leftover bread can be used, under the condtion that it is hygienically fit, as animal feed, bioenergy fuel, as well as in biofermentative processes for biogas production. The expired bread, which does not have micotoxines, metabolites of molds, can be processed by extrusion and then used as a protein-energy ingredient in animal feed for, e.g. fish and pets.

Possibility of leftover bread further proccesing and its re-use as proposed by the authors f this paper is shown in Figure 1.

Recommendations for physical-chemical, microbiological, and toxicological analysis of raw materials, half-products and final products

In relation to leftover bread valorisation in feed proccesing i biobricket production, the following parameters should be analysed:

a) Chemical analysis of raws and old bread:
   - Basic chemical composition, starch content, total and reducing sugars content, heavy metals content (lead, cadmium, mercury and arsenic)

b) Phisycal carasteristics: test weight, slip angle

c) Microbiological and toxicological analysis according to Pravilnik o maksimalno dozvoljenim štetnim materijama, Sl. List SRJ 5/92, 11/92 i 32/2002,

d) Energy value (calorimetric bomb)

Quality analysis of final products of leftover bread processing

Quality analysis should be done on brickets and animal feed by following parameters:

a) Brickets:
   - Moisture content,
   - Test weight
   - Total energy value (calometric bomb)

b) Human food and animal feed:
   - Basic chemical composition, starch content, total and reducing sugars content, heavy metals content (lead, cadmium, mercury and arsenic)
   - Phisycal carasteristics: test weight, slip angle
   - Microbiological and toxicological analysis according to Pravilnik o maksimalno dozvoljenim štetnim materijama, Sl. List SRJ 5/92, 11/92 i 32/2002. Energy value (calorimetric bomb)

4. CONCLUSION

There is a significant amount of leftover bread in Serbia, which fact represents an important ecological, health and safety issue. There is no organized way of leftover bread collection and distribution for possible further processing. As a result, there is evident increase of environment pollution and related problems in the food chain.

The main causes of the high percentage of leftover and returned bread are:

- Bread is still a social category

- Relatively low price of bread
- Relatively low level of bread quality,
- Habits of consumers, who buy more bread than they usually consume.
- Serbian people do not have habit to re-use leftover bread in their diet.

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[3] Pravilnik o mikrobiološkoj ispravnosti namirnica u prometu (Sl. list SRJ br. 2693, 5395 i 4602)
[4] Technological proposals for the implementation of practical solutions are given by the team of researchers (FINS), which has extensive practical experience in industrial conditions in the production of food for animals, plants design and design of technological procedures for pelleting and extrusion, mill and bakery plant design, as well as solving effluents problem in the mass production of food.