Possibilities of utilization of the leftover bread

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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.

**Key words:** leftover bread, quality food, environmental protection
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. Baking industry is characterized with a variety of different products that daily find their place on the market. Their quality estimate all possible generations of consumers. Stable quality of production, from the long-term point of view, is not easy to preserve. Position on the market are hardly gained, but very easily lost. In the case of so sensitive production such as the baking industry, in order of keeping of the existing positions, it is unavoidable to make all possible efforts for keeping of the achieved levels of competences. Competence is commonly expressed over three basic factors: the quality, the time and the price these factors commonly represent basic – main criteria that determine consumer’s preferences for definite products[1].

Nevertheless, consumers, which are ecustomed with the conventional flavors, with already formed their own quality criteria, and being unable even to recognize distinctive sorts of bread, or to give judgments about its quality, represent the interested customers of this industry, which are really not easy to satisfy. No educated with respect to quality, consumers very often do not know what they really seek. But, the indicative fact, which is generally accepted, is that on the market one can meet distinctive oscillations of the product quality. Goal of this work is to indicate the possible methods of estimation of products quality, whose choice could assure the demanded quality of baking industry products for the long periods of time.

Organizations wishing to implement a quality management system should identify the processes necessary to really implement the system, to establish and to understand the interactions between these processes, to document in detail each process to ensure efficient functioning and control. It is process analysis that should lead to establishing the documents necessary for a quality management system and not the documents.
Quality control aims at assessing product quality requirements, focusing on a distinct objective, “ensuring quality”. Everything needs to be well documented and observe the rule “Write what you need to do and do what you have written down!” Quality management system is a modern system of managing quality involving the entire personnel. One of the main principles of a standard is involving more in quality issues by establishing one’s own policy in the field of quality and goals to reach. Data resulted from quality management systems are used in a management analysis aimed at assessing the way goals have been reached and at designing new goals to reach, together with the need to continually improve the quality of processes and products. At present, investment in quality is, for the operators in the milling and panification industry, a safe way to increase unit competitiveness, to reduce costs and, implicitly, to sell cheaper, hence consumer fidelity and new niche markets [2].

Designing and implementing a quality management system differs from one organization to another, depending on size, structure, type of products, type of processes, goals, etc. therefore, it is imperative that each operator knows the legislation in the field, have a trained personnel, and cooperate only with accredited certification societies where they need to certify the system. For a good functioning of the organization, it is necessary to be operated and controlled systematically and transparently, which can be done by implementing and maintaining a management system designed to continuously improve performances, including quality management. High management should observe the following eight principles: operate a customer-oriented organization, leadership, involving personnel, process-based approach, approaching the management as a system, continuously improving, efficiency in decisionmaking, mutually advantageous relationships between the organization and suppliers. A quality management system should rely on the following requirements:

- general requirements:
  • establish a quality management system;
  • documenting a quality management system;
  • maintaining a quality management system);
- documentation requirements:
  • documented policy statement;
  • editing a quality manual;
  • documented procedures required by the standard;
  • documents necessary to ensure planning, operating, process
According to SR EN ISO 9001:2001, the elements of a quality management system can be ranged in four domains:
- management responsibility;
- resource management;
- product manufacture;
- product measurement, analysis, and improvement.

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.

RESULTS AND DISCUSSION

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 researches 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:

1. Raw materials quality,
2. Technology
3. Sanitation and
4. Baker’s knowledge and experiences.

Table 1 Chemical composition of different types of bread [3]

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.
4. 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.

The importance of bread for nourishment, consumers described with the following attributes:
• Main food 10.26%,
• Important 45.06%,
• Very important 25.64%,
• Less important 13.92%, and
• Negligible 4.40%.

It is clear that 81.68% of the polled population consider bred as being very important in the nourishment, and only 18.32% of population do not consider it as food of special
importance. Ranking of factors that have effects on decision about purchasing of the product, consumers priorities were as follows.

1. Product quality,
2. Product freshness,
3. Regular supplying,
4. Price
5. Assortment,
6. Kindness of salesmen,
7. Personal liability,
8. Packaging,
9. Good marketing, and

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, whereas those who do, will have a regular quarterly check ups. Leftover bread can be used, under the condition that it is hygienically fit, as animal feed, bio energy fuel, as well as in bio fermentative processes for biogas production. The expired bread, which does not have micotoxines, metabolites of moulds, 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 processing and its re-use as proposed by the authors for 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 processing i biobricket production, the following parameters should be analysed:
a) Chemical analysis of raws and old bread:

b) Basic chemical composition, starch content, total and reducing sugars content, heavy metals content (lead, cadmium, mercury and arsenic)

c) Physical characteristics: test weight, slip angle

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

e) Energy value (calorimetric bomb)

Quality analysis of final products of leftover bread processing

Quality analysis should be done on bricks 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)
   Physical characteristics: 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“]
   Energy value (calorimetric bomb)

Energy value rough cleaning ingredients source energy

Rough cleaning ingredients for rapeseed oil and cellulose content in a certain percentage than can be confused with the old moldy bread and then the briquet and peletirati bioenergetska fuel. Ingredients of crude sunflower cleaning (with aspiratera): sunflower hulls, sunflower heads and parts of the plant, because of oil and cellulose content in a certain percentage than can be confused with the old moldy bread and then the briquet and peletirati bioenergetska fuel. In processing of grain (corn, wheat, barley, oats, triticale, etc.) after cleaning and drying the aspirateirima if necessary, receive the following: harsh ingredients that make up the chaff, straw, plant parts, seeds and other weeds. Coarse grain cleaning ingredients in a certain percentage than can be confused with the old moldy bread and then the briquet and peletirati bioenergetska fuel. Old
bread processing technology can be solved by the process of briquetting and pelleting by-products from primary agricultural production, energy or fuel that the old bread (if it meets the nutritional regulation of the quality of food for animals, Sl. list 20/2000) extrusion process combined with certain percentage ratio of "fine" impurities from primary agricultural production to valorize the energy protein feed intended for animal nutrition.

CONCLUSION

Technological proposals for the implementation of practical solutions of leftover bread reuse are given by the team of researchers (FINS), which has extensive practical experience in industrial conditions in the food and feed production, so as designs of technological procedures for pelleting and extrusion, mill and bakery plant design, as well as solving problem of effluents in the mass production of food.

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.

Large amounts of impurities in the processing of cereals, soybean, sunflower, field pea, and using effluents from other biotechnologies can be a very valuable nutritional products. Our food industry is a major generator of waste, and reuse of leftover bread is way to overcome the ecological problems.
REFERENCES


[3] Pravilnik o maksimalnim količinama sastojaka u stočnoj hrani (službeni list SFRJ br 2/90 i 27/90)

[4] Pravilnik o mikrobiološkoj ispravnosti namirnica u prometu (Sl. list SRJ br. 2693, 5395 i 4602)

Table 1. Chemical composition of different types of bread [3]

<table>
<thead>
<tr>
<th>Product type</th>
<th>Flour</th>
<th>Chemical composition %</th>
<th>Bruto calories per 100 g product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rye bread</td>
<td>Wholegrain</td>
<td>45.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Pan bread</td>
<td>-</td>
<td>42.0</td>
<td>6.2</td>
</tr>
<tr>
<td>Heart bread</td>
<td>refined</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wheat bread</td>
<td>Wholegrain</td>
<td>43.1</td>
<td>7.0</td>
</tr>
<tr>
<td>Loaf</td>
<td>Dark</td>
<td>35.8</td>
<td>9.0</td>
</tr>
<tr>
<td>Bun</td>
<td>Semiwhite</td>
<td>31.7</td>
<td>9.4</td>
</tr>
<tr>
<td>Fatty baked Ware</td>
<td>White</td>
<td>35.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Toast rye butter</td>
<td>Wholegrain</td>
<td>11.0</td>
<td>11.4</td>
</tr>
<tr>
<td>- white</td>
<td>11.0</td>
<td>9.5</td>
<td>5.5</td>
</tr>
<tr>
<td>- semiwhite</td>
<td>17.0</td>
<td>10.6</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Figure 1.: Possibility of leftover bread further processing and its re-use

**LEFTOVER BREAD**

- **Bread which complies with health and safety regulations**
  - Food – complies microbiological accuracy regulations [4]
  - Extruded bread products
    - Bread croutons
    - Bread sticks
    - Bread chips
    - Bread crackers
  - Bread crumbs
  - Carrier for additives (for enlarging of water absorption)
  - Leftover bread dumplings
  - Recipies:
    - Pizza
    - Bread and water meal
    - Cheese pie
  - Re-using in food processing – should be regulated according to legislatiton

- **Bread which does not comply with health and safety regulations**
  - Feed – complies with Pravilnik o maksimalnim količinama sastojaka u stočnoj hrani (sl. list SFRJ br 2/90 i 27/90 [3]
  - Biofermentation – syntethic alcohol production
  - Brickets processing
  - Fish feed
  - Pet feed
  - Juvenil animals feed:
    - Piggs
    - Lambs
    - Bull calves
MOGUĆNOSTI KORIŠĆENJA STAROG HLEBA


Ključne reči: stari hleb, kvalitet hrane, zaštita životne sredine