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Original scientific paper

THE EFFECT OF ENVIRONMENTAL FACTORS ON THE MICROBIOLOGICAL QUALITY OF FLOURS

Ismail FERATI[1], Tatjana KALEVSKA[2], Daniela NIKOLOVSKA NEDELKOSKA[2], Petya IVANOVA[3], Namik DURMISHI[1], Gafur XHABIRI[1], Hava MIFTARI[1], Durim ALIJA[1], Rejhana LUMA[1]

[1] *Faculty of Food Technology and Nutrition, University of Tetova*
[2] *Faculty of Technology and Technical Science – Veles, University St. Clement of Ohrid - Bitola, North Macedonia*
[3.] *Institute of Food Preservation and Quality-Plovdiv, Bulgaria*
[*] *Corresponding author e-mail: ismail.ferati@unite.edu.mk*

Abstract

The flours that are obtained through the grinding process have different qualities which affect the safety aspect of the flours. During the grinding process, an attempt is made to remove the outer layer of the grain which from a microbiological point of view is contaminated by the conditions of cultivation, harvesting, transport and storage. It is a part that has a direct contact with the environment, this layer, even though it is rich in nutritional values, must be removed to ensure the safety of the product. With outer layer are also removed the aleuronic layer and the embryo, the embryo is a fat-rich structure, therefore it is removed to extending the life of the product, because a number of microorganisms have lipolytic action and change the organoleptic qualities of the final product. Our study is focused on the microbiological qualities of different flours and the moisture of the product which has a very significant effect on the development of microorganisms. The samples taken during this study were random in the market, where different flours were analyzed such as: Whole-wheat flour X1, X2 and flour type 400 X1, X2. The study analyzed the ratio of product moisture to the total number of microorganisms, molds and yeasts. The obtained results show a close correlation between the percentage of moisture and the number of microorganisms. The moisture content was higher in whole-wheat flours than in type 400 flours which also reflect in the number of microorganisms where the largest number of microorganisms is in whole-wheat flours.

Keywords: Whole-wheat flour, type 400 flour, % H, mesophilic aerobic bacteria, molds and yeasts.

1. Introduction

The flours that are obtained through the grinding process have different qualities which affect the safety aspect of the flours. During the grinding process, an attempt is made to remove the outer layer of the grain which, from a microbiological point of view, is contaminated by the conditions of cultivation, harvesting, transport and storage. Because it is a part that has a direct contact with the environment, this layer, even though it is rich in nutritional values, must be removed to ensure the safety of the product.

With outer layer are also removed the aleuronic layer and the embryo, the embryo is a fat-rich structure, therefore it is removed to extending the life of the product, because several microorganisms have lipolytic action and change the organoleptic qualities of the final product.

Based on these data our study has focused on the microbiological qualities of different flours and the moisture of the product which has a very significant effect on the development of microorganisms (Kaluđerski et al., 1989).

2. Property of flours

2.1. Categorization of wheat flour: Earlier the typification of wheat flour was done according to the color of the flour. Today typification is done based on ash content expressed as a percentage and calculated in the ratio of dry mass of flour. In addition to the ash content, for each type of flour is set the upper limit of the degree of acidity of the flour, from which its correctness depends.

In addition to these types of flour, whole wheat flour is obtained, which can have up to 2% ash, and the acidity level reaches up to 5. Flour type T - 400 is mainly used to produce bread and pasta, while the types of others of flour are used to produce bread and other products (Sinani, 2010).

Wheat flour approximately consists of 72% carbohydrates, 8 to 13% protein, 12 to 13% moisture, 2.5% sugar and 1.5% fat, 1.0% soluble protein and 0.5% minerals salts (Oberoi et al., 2007). Wheat flour is main ingredients used in the manufacturing of noodles and characteristics of wheat used for milling are very important. Soft wheat is used in cakes, pastries, cookies, crackers, and oriental noodles whereas hard wheat is used in breads.

The baking qualities of the wheat flour are conditioned by the amount and quality of the proteins in the grain (Lasztity, 2003), the high content of the proteins has a very favorable effect regarding the volume and form of bread (Pomeranz, 1988).

The quality of flour is investigated by physical and chemical methods. The physical properties of the dough play an important role in the quality of the finished baked goods. Physical research is performed with the help of more apparatus. The most popular devices are: pharyngography, extensograph, amylograph, fermentograph, etc. The most used device is the pharynx and with its help it is determined: the ability of the flour to absorb water, the physical properties of the dough, elasticity, consistency, and quality groups of flour (Xhabiri and Sinani, 2011).

2.2. Microbiological properties of wheat flour: Cereals and cereal products constitute a significant food resource for the world's population. Various spoilage micro-organisms can proliferate on cereal grains and finished products held under improper storage properties (Deibel and Swanson, 2001). Flour is generally regarded as a microbiologically safe product as it is a low water activity commodity. Although the growth of pathogenic bacteria may not be supported under such properties, pathogens that contaminate flour may survive for extended periods (Berghofer et al., 2003). There are reported cases of food poisoning resulting from contaminated flour. Australian, European, and US studies indicate that Salmonella spp., Escherichia coli, Bacillus cereus, and other spoilage micro-organisms are present in wheat and flour at low levels (Richter et al., 1993). In addition, mold growth in flour is known to decrease its quality significantly. Mold contamination on cereals, which can exist at the farm or at the site of storage, affects the yield, quality, and nutritional value of the products (Aran and Eke, 1987). When the water content exceeds the alarm level for wheat flour (13%-15%) molds start growing (Jay, 1996). This situation illustrates how some chemical parameters could affect microbiological parameters.

The mycological profile of retail wheat flour is somewhat similar among reports found in the literature. Aspergillus and Penicillium species (storage fungi) have been recorded among the most prevalent ones in wheat flour by many authors. Riba et al. (63) evaluated the microflora of Algerian soft and durum wheat flour, especially for the presence of Aspergillus strains and its potential for ochratoxin A production. Results showed that fungi of the genus Aspergillus prevailed (95%) in soft wheat flour, while in durum flour Penicillium (43%) was as abundant as Aspergillus (57%). High frequency of ochratoxigenic species of Aspergillus was detected in all flour samples, being A. candidus the most predominant specie in both soft flour (47%) and durum flour (31%). Similar results were reported by Weidenbörner et al. (98) in commercial samples of white and whole-grain flour in Germany. The microbiota of whole-grain and white flour was dominated by Aspergillus spp. accounting for 84% and 77.3% of the isolations, respectively. A. candidus was also the most frequently encountered mold. From the 3,325 isolations, 93.3% belonged to 32 fungal species that are well known for

their mycotoxin producing potential. Likewise, the most common genera isolated in 50 retail wheat flour samples from Saudi Arabia were Aspergillus (70%) and Penicillium (30%) (Richter et al., 1993).

3. Materials and method

The samples from this study were taken randomly from the market, different flours were analyzed: X1 Whole wheat flour, X1 / 1. Flour type 400 from the same manufacturer X1, X1/1 Flour type 400. The study analyzed the ratio of product moisture to the aerobic mesophilic bacteria and yeast and molds.

4. Results and discussion

The results obtained during this study that are reflected in Table 1, reflect a correlation of the number of microorganisms with the moisture of the product. Whole wheat flour usually contains higher amounts of moisture. While type 400 flours from different manufacturers have a difference in moisture and the number of microorganisms. The methods that were used are: ISO 4883:2019 Aerobic mesophilic bacteria, yeast, and molds ISO 21527-2:2018, determination of moisture content Xhabiri, G., Sinani, A. 2011.

Table 1. Results of microbiological and moisture analysis

Analysis	X1 whole wheat flour	X1 / 1 Flour type 400 from the same manufacturer of X1	X2 Flour type 400
Yeast and molds	47 cfu/ml	15 cfu/ml	3 cfu/ml
Aerobic mesophilic bacteria	13 cfu/ml	9 cfu/ml	5 cfu/ml
Humidity	13.6 %	11.4	11.1%

4. Conclusions

Based on the literature data and the results obtained during this study we can reach the following conclusions:
The flours obtained in the study meet the microbiological safety criteria according to the regulations in force.
Whole – heat flour contains the highest number of molds and yeasts and the highest moisture content (13.6%).
Type X1 / 1 flour has a higher number of microorganisms and a higher percentage of moisture compared to type X1 flour 400.
There is a close interaction between the percentage of moisture and the number of microorganisms.

References

[1]. Aran, N., Eke, D. 1987. Mold microflora of some Turkish cereals and cereal products. MIRCEN Journal, 3, 281-287.
[2]. Berghofer, L.K., Hocking, A.D., Miskelly, D., Jansson, E. 2003. Microbiology of wheat and flour milling in Australia. Int J FoodMicrobiol, 85, 137-149.
[3]. Deibel, K.E., Swanson, K.M.J. 2001. Cereal and cereal products. In: Microbiological Examination of Foods, (Ed PF Downes, K Ito), American Public Health Association, Washington DC, pp. 549-552.
[4]. Jay, M.J. 1996. Modern Food Microbiology. New York, Chapman and Hall.
[5]. Kaluđerski G., Žeželj, M., Gavrilović, M., Smiljka Kaluđerski, S., Tošić, B. 1989. Tehnologija proizvodnje i prerade brasna, Zavod za izdavanje udžbenika i zavod za udžbenike i nastavna sredstva, Novi Sad.
[6]. Lasztity, R., 2003. Prediction of wheat quality-success and doubts. Periodical politechnica Ser. Chem. Eng. 46, 39-49.
[7]. Oberoi, D.P.S., Sogi, D.S., Gill, B.S. 2007. Noodle Processing Technology. Bev. Food World, 34(10), 68-72.
[8]. Pomeranz, Y. 1998. Composition and functionality of wheat flour components. In Wheat: Chemistry and Technology (vol.2), ed. Pomeranz Y. American Association of Cereals Chemists, St. Paul, MN, USA, pp 219-370.
[9]. Riba, A., Mokrane, S., Mathieu, F., Lebrihi, A., and Sabaou, N. 2008. Mycoflora and ochratoxin A producing strains of Aspergillus in Algerian wheat. International Journal of Food Microbiology, 122, 85–92.

Richter, K.S., Dorneanu, E., Eskridge, K.M., Rao, C.S. 1993. Microbiological quality of flours. Cereal Food World, 38, 367-369
[10]. Sinanai, A. 2009. Teknologjia e përpunimit të drithërave, Maluka, Tiranë.
[11]. Xhabiri, G., Sinani, A. 2011. Analizat laboratorike të drithërave, miellrave, brumërave dhe produkteve të pjekjes (Laboratory analysis of cereals, flour, dough, and bakery products), Çabej, Gostivar-Tirana.
[12]. Weidenbörner, M., Wieczorek, C., Appel, S., Kunz, B. 2000. Whole wheat and white wheat flour—the mycrobiota and potential mycotoxins. Food Microbiology, 17, 103–107.