THE EFFECT OF MOISTURE ON THE STORAGE OF FLOUR AND GROATS

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Anonotatsiya : *Ushbu maqolada un va yorma mahsulotlarining saqlashda namlikning ta'siri o'rganiladi. Namlik darajasi mahsulotlarning fizik xususiyatlarini, shu jumladan sochiluvchanlik, g'ovaklik va sorbsion xossalarini o'zgartiradi. Maqolada namlikning oksidlanish va achchiqlanish jarayonlariga ta'siri, shuningdek mikroorganizmlar rivojlanishi va ularning mahsulot sifatiga ta'siri ham tahlil qilingan. Yuqori namlikda mikroorganizmlar tez rivojlanib, mahsulot sifatini yomonlashtiradi, shuning uchun saqlashda namlikni nazorat qilish muhimdir. Maqolada un va yorma mahsulotlarining issiq-fizik xossalari ham ko'rib chiqilib, namlikni nazorat qilishning saqlashdagi ahamiyati ta'kidlangan.*

Аннотация: *В данной статье изучается влияние влажности на хранение муки и круп. Уровень влажности изменяет физические свойства продуктов, включая сыпучесть, пористость и сорбционные характеристики. Также анализируется влияние влажности на процессы окисления и прогоркания, а также развитие микроорганизмов и их влияние на качество продукции. При высокой влажности микроорганизмы быстро развиваются, ухудшая качество продуктов, поэтому контроль влажности при хранении имеет важное значение. В статье также рассматриваются теплофизические свойства муки и круп, подчеркивается важность контроля влажности в процессе хранения.*

Annotation: *This article examines the impact of humidity on the storage of flour and cereal products. The humidity level affects the physical properties of the products, including flowability, porosity, and sorption characteristics. The article also analyzes the effect of humidity on oxidation and rancidity processes, as well as the development of microorganisms and their impact on product quality. At high humidity, microorganisms develop rapidly, deteriorating the product quality, making humidity control crucial during storage. The article also discusses the thermophysical properties of flour and cereals, emphasizing the importance of humidity control in storage.*

Key words: *Humidity, flour storage, cereal storage, flowability, porosity, sorption properties, oxidation, rancidity, microorganisms, product quality, humidity control, thermophysical properties, moisture saturation, condensation, gas exchange, insect pests, autolysis, fat hydrolysis, enzymes, proteins, gluten, ash, vitamins, flour grade, wheat flour, rye flour, cereal products, temperature fluctuations, ventilation, product spoilage, self-heating, mold, flour rancidity, humidity regulation.*

The role of moisture in the storage of flour and groat products is of great importance. The processes related to the moisture content of flour, unlike other factors, stop and even slow down the rancidity of flour. Moisture primarily prevents the oxidation of flour by limiting the interaction between air and flour. However, high moisture content promotes the growth of microorganisms, which deteriorates the quality of the products. The rancidity process of flour is directly dependent on the moisture content. According to N.N. Sosodova's data, wheat flours with a yield of 78% begin to deteriorate after four months of storage at moisture levels of 12%, 13%, and 14%, and this process is fully completed by the sixth month. However, flours with 15-16% moisture did not show rancidity. This explains how moisture helps prevent oxidation of flour and slows down microbiological processes.

Moisture limits the absorption of air by the flour, which helps prevent oxidation. However, high moisture content creates ideal conditions for microorganisms to thrive. Therefore, controlling moisture during the storage of flour is crucial. In places where flour is stored, sunlight can accelerate the rancidity process, but this factor does not significantly affect the quality of the flour since it is typically stored in closed environments. Microorganisms are always present in flour, and under certain conditions, especially with high moisture, they find a good substrate for development. Cleaning processes help reduce the number of microorganisms, but if washing or drying procedures are not done on time, the microbial count may increase. It is essential to take necessary measures to limit microbiological processes during storage. Mold growth, souring, or self-heating can occur due to microbial activity, so it is necessary to prevent such activities during storage.

The flowability of flour and groats also changes under the influence of moisture. The flowability of flour is lower than that of grains because it consists of finer particles. As moisture increases, the flowability decreases. At moisture levels of 16% or higher, flowability significantly decreases. The flowability of groat products varies depending on the type of grain used. For example, rice groats have higher flowability compared to rice grains, and barley groats have higher flowability compared to barley grains.

The porosity of flour and groat products also changes with moisture. Due to the very fine particles of flour, its porosity consists of small, crack-like voids. This reduces gas exchange and slows down the activity of harmful insects. As moisture increases, this porosity is affected, which contributes to the development of microbiological processes. Therefore, it is essential to consider their physical properties and control moisture when storing flour and groats.

Flour and groat products can absorb or release moisture, gases, and odors from the environment. However, the sorption properties of flour and groats are lower

compared to grains, primarily due to their smaller porous structure. Flour and groat products should be cooled before storage, as excess moisture negatively affects their quality. Temperature fluctuations can lead to the formation of condensation moisture, which accelerates microbiological processes.

The thermal-physical properties of flour and groat products also interact with moisture. Like grains, flour, groats, and bran have low thermal conductivity. This reduces the combined effect of heat and moisture. The retention of moisture and a drop in temperature can lead to the formation of condensation moisture, which accelerates microbiological processes. Therefore, storage areas for flour and groat products should be well-ventilated, and cooling processes should be taken into account.

The chemical composition, nutritional value, and technological quality of flour primarily depend on the type of grain, its variety, grinding method, and flour yield (percentage of grain mass). Currently, the flour industry produces premium, first-grade, second-grade, and bran flours from wheat. The chemical composition of premium wheat flour is as follows (%): water – 14, carbohydrates – 73.6, proteins – 10.8, fiber – 0.2, fats – 0.9, ash – 0.5. For first-grade flour, these values are 14, 72.9, 11.0, 0.3, 1.1, and 0.7, respectively, while bran flour has 14, 69.6, 11.8, 1.6, 1.5, and 1.5. Bran and second-grade flours contain vitamins V1, V2, RR, and E, whereas premium and first-grade flours have little to no such vitamins. Flour contains various enzymes (proteinases, amylases, catalase, lipase, etc.) that influence the bread-making process and its quality. Rye flours are typically produced in one grade, as well as 96% one-grade wheat-rye flours (70% wheat, 30% rye) and 95% one-grade rye-wheat flours (60% rye, 40% wheat). Based on the flour's yield and grade, the color, powderiness, ash content, gluten quantity, and quality are standardized. High-quality flour has a distinctive smell and a sweet taste.

During the storage of flour, its quality may change. In the initial stage, i.e., within the first month, flour stored at a high temperature (20-30°C) undergoes a "ripening" process where the fats undergo hydrolysis and oxidation, which improves its quality. However, prolonged storage leads to a deterioration in its quality. The moisture content of flour should not exceed 15%. If moisture increases, the flour will become rancid, moldy, and self-heat. If moisture is too low (9-13%), the flour will deteriorate rapidly. Due to its ability to absorb moisture and odors, flour should be stored in a dry, cool place away from odorous products. For high-quality flour, the gluten content should be from the first or second group, and this content should be at least 20-30%.

Conclusion:

The effect of moisture on the storage quality of flour and groat products is significant. The moisture level alters the physical and chemical properties of the products, including flowability, porosity, and sorption characteristics. Moisture controls the oxidation of flour and the development of microbiological processes, while high moisture promotes the growth of microorganisms, leading to a decline in product quality. It is essential to maintain balanced moisture levels during storage, as high moisture can promote microbial growth, while low moisture can cause rapid deterioration of flour. Therefore, it is crucial to control moisture levels and storage conditions when storing flour and groat products. Temperature, moisture, microbiological processes, and the chemical composition of the product should all be considered, as these factors directly influence the quality of flour and groat products.

Literature

1. Uljayev, E., Ubaydullaev, U. M., Narzullayev, S. N., & Norboyev, O. N. (2021). Application of expert systems for measuring the humidity of bulk

materials. *International Journal of Mechatronics and Applied Mechanics*, (9), 131-137.

2. Ulzhaev, E., Narzullaev, S. N., & Norboev, O. N. (2021, January). Substantiation of application of artificial neural networks for creation of humidity measuring devices. In *Euro-Asia Conferences* (Vol. 1, No. 1, pp. 86-91).

3. Norboev, O. N., Farxodov, S. U., Eshonqulov, M. N., & Ibragimov, B. S. (2021). Mathematical model of a high-frequency moisture mete forcotton seeds based on substitution schemes. *Web of Scientist: International Scientific Research Journal*, *2*(05), 674-686.

4. Ulzhaev, E., Narzullaev, S. N., Norboev, O. N., & Abdikhalilov, O. U. (2021, March). MOISTURE METER FOR POWDER BULK MATERIALS. In *Euro-Asia Conferences* (Vol. 3, No. 1, pp. 115-117).

5. Narzullayev, S. (2022). NECESSITY OF GRADUATION AND CALIBRATION OF MOISTURE METERS. *Open Access Repository*, *8*(2), 5-8.