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Impact on Nutritional Value Brought By Microbial Activities in Stored Wheat Grain: An Analysis

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Abstract - The storage structure was the most important factor in this study which greatly influenced the quality of the stored cereals. It has been observed that earthen pots have retained most of the quality characteristics, i.e. the lowest moisture content, the highest test weight, the flour yield, the water absorption capacity, the quality score of Chapatti and the lowest microbial count. The second suitable storage material was a cotton bag. It showed lower humidity, high test weights, flour yield, and gluten content and adequate drops. Polypropylene bags can be classified as the third ones that show the greatest stability of the dough for gluten, FQN, with the lowest fatty acidity in stored cereals. Jute bag cereals showed less fatty acidity, greater dough stability and a better chapatti quality score, while tin can cereals with less fatty acidity, greater water absorption and better chapatti quality score were studied in this research with three varieties, namely, HD2329. PWB343 and UP2338 have been selected in consecutive years, i.e. 2013-14 and 2014-15 have been stored in four different containers (earthen containers, tin containers, jute bags, polypropylene bags) up to one year in environmental conditions and significant results have been found.

KEYWORD: Nutritional Value, Microbial Activities, Stored Wheat Grain

I. INTRODUCTION

Food, clothing, and shelter are the primary needs of human beings, whose food occupies first place. The population still depends upon the agriculture sector directly or indirectly, it forms the backbone of the Indian economy. The agricultural sector continues to be the backbone of the Indian economy, since 3/4 of the population depends on agriculture, contributing approximately 3.0% of the 51 million tons of food grain production in 1950 -51, reached a production of 218 million tons during 20l0-11, resulting in a substantial stock reserve in the last six decades. Further, the country secured a record collection of 93.90 million tons of wheat in 2011-12 (Anonymous 2012).

The wheat from which flour is acquired is a crude agricultural item is vulnerable to any type of microbiological and pest attack, making it susceptible to contamination. The physical procedures performed, including the pounding, impact the degree of contamination persisting in the grain. The very procedure of pounding, although can decrease the concentration of Mycotoxins and microorganisms, it potentially transfers the toxins to parts carrying nutritional value, hence challenge the nutritional security. Thus, most of the procedures or operation performed must utilize treatments that guarantee nutritional security. Microbial contaminants are likely to be present to a certain degree in wheat-based foods. Warmth treatment is conducive to reduce the presence of microbial contamination to a substantial degree addressing the health

issues. Irrespective of the treatment, negligible level of mycotoxin levels are subsequently present with wheat-based like bread, pasta, and oats.

Agricultural Development and its Challenges

Agricultural sector in the 21st century is confronted with multiple challenges relating to food security, population, environment, climate change, and resource conservation. Among the numerous concerns, improved storage facilities of agricultural produce at the farm level form the fundamental requirement for farmers to enable farmers negotiate for better price of their produce. The inability of farmers to store their products , otherwise forces them to sell their products shortly after harvest at lower market prices, which generates economic losses.

For an agrarian economy like India, where over seventy percent of people are engaged in agriculture for their livelihood, agriculture assumes particular importance for scheme of national development. The green revolution in the country has impounded the production of food grains almost three folds since independence. Indian farmers have made significant strides in producing food grains under the guidance of scientists. Farmers have quickly adopted high-yielding varieties, fertilizers, pesticides, etc.

Main factors influencing the quality of cereals and its Impact

In developing countries, particularly in India, most of the cereals produced are stored at farm level, where quantitative and qualitative losses occur due to physical factors (temperature and humidity), biological (organic microorganisms, insects, rodents, birds and mites), chemicals (decomposition of products and pesticides) and engineering factors (structural and mechanical aspects).

It has been estimated that the nation loses about 10% of cereals due to unscientific conservation practices, rodents, insects, and climatic factors. This means losing about 20 million tons of cereals every year due to faulty storage and ignorance of post-harvest scientific operations.

Storage of Food Grains

Preservation of cereals in traditional structures, such as mud-based storage bins, soil, underground structures, jute bags, etc., alludes to significant losses of wheat both in terms of quality and quantity due to the effects of humidity and insects. Toxic chemicals, while protecting the grain during storage, can be harmful to long-term health.

Post-harvest management Pattern

Post-harvest management is a multidisciplinary technology, which aims to provide quantity and quality nutrition through scientific conservation. It includes all the operations, such as cleaning, selection, drying, storage, extraction, grinding, packaging, and transport performed on an agricultural product from the initial harvesting stage to consumption.

Prevention of Microbial Establishment

Dissimilar to warm treated foods, chilled pasta items can speak to a significant safety chance because the consumption of homemade pasta is by all accounts a prominent practice among purchasers. With expanded utilization of flour in chilled and solidified items, the low occurrence of pathogen contamination in wheat flour ought not to be disregarded; it should instead legitimize the use of further treatments to make the flour more secure for human consumption. Depending just on instructing buyers on the health dangers related to the consumption of crude bites may not ensure the nonappearance of food safety occurrences. Eating items furthermore, to guarantee safety, different control systems ought to be utilized to decrease the microbial load and Mycotoxins in flour and flour-based items. These incorporate the

prevention of microbial development and foundation inside the plant and along the generation chain through right sanitation of hardware, precise temperature control during cooking, an examination of approaching grain, and coming about flour and strategies clean packaging and sending.

II. OBJECTIVES

- To study of varietal effects on storage structures/ containers on the storability of wheat grain and flour.
- To explore the origin and classification of wheat with its nutritional value

III. MATERIALS AND METHODS

Selection of Materials

Three varieties of wheat grain and flour will be selected and stored in different containers to study the impact of storage on quality of wheat grain and flour as under: Varieties took: HD2329, PWB343, UP2338

Sample of grain of certified wheat varieties will be collected from market/ Govt. agencies such as IARI or any other relevant agency.

Method

The wheat was fumigated with phosphine and stored in four types of a 20 kg container under existing environmental conditions in a room for one year. Temperature / humidity records were maintained. The warehouses were ventilated with the door opening during the day. The containers were opened twice a week and the grains were stirred with a wooden rod to avoid the impact of localized temperature or humidity.

Four different containers were taken as follows:

- Earthen Pot
- Metallic or Tin Container
- Jute Bags
- Polyethylene or Polypropylene Bags

Procedure of Analysis

For an analysis, samples were drawn after every four months and analyzed for physical parameters, chemical composition, dough rheology/farinograph, microbial investigation and baking quality/chapatti quality(AACC 2000).The Statistical analysis included ANOVA using a three-factorial factorial with a complete randomized block design applied. The media were compared by applying the Duncan multiple range test at P = 0.05.

IV. THE ORIGIN AND CLASSIFICATION OF WHEAT

Wheat has a place with the genus *Triticum* of the herb family, Poaceae. This genus starts in the tropical south-west of Asia, where it is discovered both uncontrollably and developed. Wheat is very much adjusted to hostile environments and is mostly developed in desolate territories that are excessively dry and unreasonably cold for rice and maize with a more prominent tropical tendency, which work better at transitional temperature levels. Wheat was first developed in the United States in 1602 on an island off the bank of Massachusetts (Mathew Shiju, 2010).

Man has relied upon the wheat plant for a huge number of years. The hereditary qualities of wheat are more confused than that of most other residential species. Some wheat species are diploid, with two arrangements of chromosomes, however many are steady polyploids, with four arrangements of chromosomes (tetraploids) or six arrangements of chromosomes (hexaploids).

All inclusive, wheat is the most delivered food among oats after rice. Table 1 demonstrates the ordered status of the genus *Triticum*.

Table 1 The Taxonomical status of *Triticum*

Kingdom	Plantae	Plants
Subkingdom	Tracheobionta	Vascular plants
Superdivision	Spermatophyta	Seed plants
Division	Magnoliophyta	Flowering plants
Class	Liliopsida	Monocotyledons
Subclass	Commelinidae	
Order	Cyperales	
Family	Poaceae	Grass family
Genus Species	*Triticumaestivum L.*	Wheat Common wheat

VII. STORAGE EFFECTS ON WHEAT QUALITY

In numerous parts of the world, protecting grain quality during storage is a problematic issue (Gras et al., 2000). Poor storage quality can limit the nutritional value, its physical characteristics, and other physico-substance conditions. The impact of storage on grain quality can be identified with the timeframe of storage usability and storage conditions, natural conditions, and various other analytical measures.

Effect of Composition on Grain Damage

Various examinations have eluded the significance of the composition of wheat in comprehending the effects during conservation practices. In food items, there are numerous natural, synthetic compounds with antimicrobial properties, bug sprays, and pesticides that counteract or and disintegrate the food items. Waqas et al. (2003) demonstrated that bug sprays have a positive correlation with the sugar substance of wheat.

Tabassum et al. (1983) emphasized that rough fibers can potentially diminish grain damage and weight reduction. Hameed et al. (1984) observed that varieties high in fat, fiber, ash, and protein are less subjected to insect attack during storage. The *Sitophilusoryzae* emphatically determine the size and brittleness of the grain along with its protein content. In contrast, different elements, for example, grain weight, grain number, grain shading, gluten substance, and sedimentation value, did not have any effect on impact of the insects.

V. NUTRITIONAL VALUE OF STORED WHEAT GRAIN AND FLOUR

Wheat-based foods have been considered among the most secure of all foods created for human consumption. To some degree, this announcement reflects both the generally safe profile of low moisture content foods and the warm procedures used to create the completed item. Notwithstanding, raw flour contains several potential risks, which, if not appropriately oversaw, can have positive ramifications for general health. These threats are mostly of the microbiological starting point and emerge chiefly during production and circulation through the grain store network. The physical procedures performed during processing minimally affect the degree of contamination present in the grain; therefore, the underlying microbiological quality of the grain of wheat impacts the quality and safety of the last granulating items. While most flour-based foods are prepared and devoured in manners that are more averse to be defiled with

pathogens, many chilled pasta items represent a significant hazard to customer health safety, as they are bound to be Eat crude or half-cooked. Various episodes have demonstrated the likelihood of introduction to pathogenic microorganisms present in crude flour by eating a crude cooking blend. Such episodes identified with food safety have prompted expanded consciousness of the maker and purchaser regarding the safety-related with food containing flour.

Nutritional Value of Wheat Grain and Flour

Wheat is viewed as a decent source of proteins, minerals, B vitamins, and dietary fibers, which is a health food source. In this way, it has turned into the primary grain, being more broadly used to make bread than some other oat crops because of the quality and amount of its trademark protein called gluten. Gluten makes the bread mixture stick and enables it to hold gas. Wheat has a few therapeutic excellences; Starch and gluten in wheat give warmth and vitality; The internal layers of grain, phosphates and other mineral salts; the outside grain, the essential feed, the non-absorbable part that helps the simple development of the digestive organs; the germ, the vitamins B and E; and wheat proteins help construct and fix muscle tissue. Wheat germ, which is dispensed within the refining procedure, is additionally wealthy in fundamental nutrient E, the absence of which can prompt coronary illness. The loss of vitamins and minerals in refined wheat flour has prompted a far-reaching predominance of stoppage and another stomach related issue and nutritional issue. Whole wheat, which incorporates grain and wheat germ, accordingly, secures against diseases, for example, obstruction, ischemia, coronary illness, colon diseases called a diverticulum, a ruptured appendix, stoutness, and diabetes. To improve the quality, just as the measure of protein/starch and the substance of vitamins, essential amino acids, minerals, and other sound parts of wheat, it is essential to comprehend the atomic and genetic control of different parts of plant development and advancement.

VI. EXPERIMENTAL ANALYSIS OF STORAGE EFFECT

Wheat grains of three varieties Namely HD2329. PWB343, and UP2338, harvested in consecutive years i.e. 2013-14 and 2014-15 were stored in four different (Earthen pots, Tin containers, Jute bags, Poly propylene bags) containers up to one year at ambient conditions. Results of various quality parameters analyzed are being discussed in the following Sections:

Storage Effects on Moisture of Stored Wheat Grain and Flour

Moisture is one of the most important factors influencing the quality of the flour, since the quantity of dry matter is the important economic attribute of wheat. The moisture content of the grains is strongly influenced by the relative humidity and the temperature of the storage environment. During this study, as mentioned in the materials and methods, the moisture content of the wheat grains was determined before storage and every four months or a year. The results were statistically evaluated.

Storage Results for the duration of 2013-14

The results of the humidity of the grains stored in the 2013-2014 period are presented in the table. It was observed that the moisture content was strongly influenced ($p < 0.001$) by the type of container in which the grains were stored. The highest humidity was observed in polypropylene and jute bags and the lowest value was observed in storage in tin pots.

Table 1: Interactive effect of storage periods and varieties on moisture contents (%) of wheat grains during 2013-14 (VxP)

Variety/Periods	0 Month	4 Month	8 Months	12 Months	Means
HD2329	8.35	8.2	9.3	8.91	8.69
PBW343	8.18	8.03	8.99	8.75	8.49
UP2338	8.25	8.1	8.69	8.77	8.45
Means	8.26	8.11	8.99	8.81	8.54

LSD ($p \leq 0.05$) =0.1752

Table 2: Interactive effect of storage periods and containers on moisture contents (%) of wheat grains during 2013-14 (PxC)

Periods /Containers	Earthen pot	Tin pot	Jute bag	Polypropylene bag	Means
0 Month	8.26	8.11	8.11	8.11	8.15
4 Months	8.51	8.36	9.24	9.64	8.94
8 Months	8.67	8.52	9.1	9.02	8.83
12 Months	8.83	8.68	8.94	9.35	8.95
Means	8.57	8.42	8.85	9.03	8.72

LSD ($p \leq 0.05$) =0.205

Table 2, which reveals that no significant change in grain moisture was observed in the can for up to 12 months and contained more or less the same humidity as the phase initial conservation. Grains stored in tin pots, jute bags and polypropylene bags gained moisture for the duration of storage.

Storage Effect on Test Weight

The variation of moisture during this storage period, it is evident that in 2013-14 only observed an increase of 0.58 percent compared to 2.27 percent during 2014-15, which have a negative impact on the weight of the test. The diversity was also found in the test weights of wheat stored in different containers, being lower in jute bags and polypropylene bags due to the higher humidity values of the wheat.

Storage Effects on Color Grade

The results indicate that the nature of the varieties and the duration of conservation had a reproducible and very significant effect on the color. In 2013-14, PBW343 and UP2338 had the highest color quality values during the entire storage time, followed by HD2329. The duration of storage in a very significant way ($P < 0.001$) increased the degree of color in 4 months in the three varieties. UP2338 had the highest color value in all containers and the shelf life and the lowest value was found in HD2329 as in 2013-14.

Storage Effects on Protein Content

The present study revealed that in both years the containers did not contribute to the increase in crude protein content, therefore there is no preference for the container used in this regard. Varietal difference was also found significant during this study, which was highly anticipated due to its different genotype. As is evident in the table in chapter 4, the crude protein content increased in the first 4 months of storage. It can be seen that in HD2329 the protein content

decreases in the first four months of storage, after it has remained unchanged. Changes in organic nitrogen-based seed proteins would normally be unexpected, as mature seeds are considered metabolically inactive. However, it is also known that seed proteins and carbohydrates undergo chemical changes, particularly in the first weeks / months of storage, resulting in an ultrastructure of these ingredients. In this study, an increase in protein content was observed after the first four months of storage, which is difficult to explain.

Storage Effects on Crude Fat

The alternative variation of fat can be attributed to the activity of the lipase enzyme in the grain of wheat at different temperatures and humidity, which breaks down fats into free fatty acids. Nasir et al. (2003) observed a decrease in fat content with higher humidity in wheat grains. The containers independently could not play any significant role in both years.

Storage Effects on Crude Fiber

The comparison of the results obtained over the two years is similar only for the duration of the storage which shows a significant difference and for the containers which show an insignificant difference. All other factors showed no consensus between the two-year analyzes. The crude fiber content of the grains stored in all containers was the same, i.e. no effects were observed in the containers during both years. In the first year, no significant change in crude fiber was observed for up to 4 months, an increase was observed during the rest of the shelf life, while when repeated in the following year it increased in storage after 4 months, but remained constant if extended to one year.

Storage Effects on Gluten

The result concludes that polypropylene bags, jute bags and tin can were better at preserving the gluten content of wheat in one year, while in the second year all ships behaved similarly. Muchova and Frankcakova (1980) also observed that the wheat and triticale varieties maintained the wet gluten content in the first year of storage, but the deterioration occurred in the second year, the reduction of proteins and wet gluten was particularly marked. The present study agrees with those of Hruskova and Machova (2002) who observed that the gluten content tended to decrease over time, but the difference did not seem significant for the quality of the flour.

Storage Effects on Falling Number

The amount of amylase that can be tolerated based on the bread making process. For example, several domestic breads, including Moroccan bread with sourdough, Moroccan pasta, whole meal bread, chapatti and four types of Indian bread, are very tolerant of damaged sprouts in the wheat used.

Storage Effects on Fat Acidity

The different packages used in this study influenced the acidic value of fat. Tin pots, jute bags and polypropylene bags maintained relatively lower values than the mud and cotton bags. Bakshi and Sharma (1993) also found rapid acidification in the grain stored in cloth bags compared to the glass bottle or refrigerator. Marathe et al. (2002) showed a 22 to 55 percent increase in fatty acidity in wheat flour stored in polyethylene bags at room temperature (27-33 ° C) and humidity (59-87 percent) for six months. Healthy wheat has a fatty acidity of about 20 mg of KOH / 100 g. The deteriorated grain in storage has high values of fatty acidity and in extreme cases it can exceed 100 mg / 100 g (Baker et al., 1959).

Storage Effects on Water Absorption Capacity

The two-year data analysis revealed reproducible results for all factors and their interactions. It was revealed that the best containers, that is, which retained the maximum water absorption capacity, were the earthen pots, while the tin ones occupied the next place in this sense. The role of other containers was different in both years. An increase in water absorption was observed in the first four months of storage.

Storage Effects on Dough Stability

The results of two years of conservation constantly show that jute and polypropylene bags seem to be the best for having a positive effect on the stability of the mass of the stored grain. The shelf life also improved the stability of the grain mass. HD2329 achieved the highest value in both years. Many researchers working on mass rheology have also demonstrated the favorable effects of storage on mass stability.

Storage Effects on Farinograph Quality Number

It is evident in both years that the storage produced a better rheological quality of the flour, mainly in 4 months, reduced in 8 months and then increased after 1 year in duration. Polypropylene bags had a positive effect on the FQN during the two years, while in 2014-15 the grains in the cotton bags also had the highest FQN. The maximum increase in FQN was found in HD2329, while the maximum FQN at the start of the experiment was observed in UP2338. The data also suggest that HD2329 is the best variety for short-term storage, while two other varieties are suitable for longer shelf life.

Total Plate Count

The results of both years showed that earthen pots were a better storage option, allowing lower TPC after tin pots for all varieties and shelf life. The shelf life had a significant effect on microbial growth. The varieties also showed no significant differences in the total plate count. the previous year the earthen pots turned out to be the best storage containers that allowed the lowest TPC followed by tin pots for all varieties and durations of conservation. Microbial load increased with advancing shelf life, while varieties showed no difference in microbial growth.

Storage Effects on Fungal Colony

In both years the effect of the packaging was not significant. The shelf life increased the fungal infection. Similarly, Malaker et al. (2008) observed that the prevalence of fungal gradually increased in all pots (bamboo cake, earthen jug and tin container and polyethylene bag at 25-30 ° C) with the exception of the refrigerator at 10 ° C. The largest fungal population was observed when the seeds were stored without work, followed by an earthen pot, a tin container and a polythene bag.

Storage Effects on Chapatti quality

It is evident in both years that the storage produced a better rheological quality of the flour, mainly in 4 months, reduced in 8 months and then increased after 1 year in duration. Polypropylene bags had a positive effect on the FQN over the two years, while in 2014-15 tinned grains also had the highest FQN, a slight decrease in the quality of the chapattis prepared from wheat.

VII. CONCLUSION

As the Wheat is a staple food for most of the world's population, including India. An appreciable quantity of wheat and flour is damaged during storage. Therefore, adequate conditions of storage of wheat and wheat flour can generate a considerable improvement in the

national economy by controlling losses both in terms of quantity and quality. Information on biochemical changes in wheat and wheat flour due to storage in different household containers and their effect on products is scarce or obsolete. Consider the facts, and this study is designed to study different containers together with quality parameters during the conservation course at a given time.

It showed lower humidity, high test weights, flour yield, and gluten content and adequate drops. Polypropylene bags can be classified as the third ones that show the greatest stability of the dough for gluten, FQN, with the lowest fatty acidity in stored cereals. Jute bag cereals showed less fatty acidity, greater dough stability and a better chapatti quality score, while tin can cereals with less fatty acidity, greater water absorption and better chapatti quality score were studied in this research with three varieties, namely, HD2329. PWB343 and UP2338 have been selected in consecutive years, i.e. 2013-14 and 2014-15 have been stored in four different containers (earthen containers, tin containers, jute bags, polypropylene bags) up to one year in environmental conditions and significant results have been obtained.

The future research can counter on the "assembled protein nanoparticles in grain in food and its nutrition applications on storage" would more be futuristic.Further studies on exploiting protein-based nanoparticles have focused on developing technologies in extraction of proteins from sources and assembly of nanoparticles in different environmental condition. Future studies may include the differential effect on gluten fraction i.e. gliadin, glutenin and so on.

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