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Total Fungal Count and Changes Triggered in Pysico-Chemical Properties of Stored Wheat Grain.

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Abstract: Environmental and climatic conditions have been worsening with each increasing day, which is leaving a direct effect on food commodity and creating many issues of contamination related to health. Among all contaminants the Mycotoxin, create a serious hazardous problem in the agricultural sector as well as leaving negative consequences on human health and are known as potent mutagenic, carcinogenic, and teratogenic and may cause death in severe cases, after ingestion or exposure. Pakistan being an agricultural country producing large quantities of wheat annually, due to climatic condition such as humidity and drought creating the problemof aflatoxin production in crops during growth at fields and this problem expands during storage, which becomes a major cause of wheat loss, effected quality and make wheat unsuitable for human consumption. For this purpose wheat samples was taken from the storage houses to assess their mycotoxin load and their impact on chemical properties of grain. It was observed from present research dissertation that after long storage period wheat carrying high load of fungi that produce different mycotoxins due to presence of high moisture content which decreases the grain quality by deteriorating the starch, protein and hardness level.

Keywords: Mycotoxins, Wheat, Godowns, Physico-Chemical

1. INTRODUCTION

Wheat (*Triticumaestivum*) belongs to family poaceae and is known as a staple food, consumed globally for 35% of the total world population, fulfilling 20% caloric requirement by providing 55% of the carbohydrates (USDA, Bermin and Garur, 1995). Wheat is highly nutritious, containing high ratios of carbohydrates and protein, all essential amino acids, minerals, phosphorus, magnesium, iron, copper and zinc and thiamine, riboflavin, niacin and vitamin E (Farooq *et al.*, 2001; Khan and Zeb, 2007). Bakery goods like bread, flat breads, chapattis, naans, pasta, biscuits and cakes are made from wheat by milling huge quantities of wheat grains into flour (atta, a highextraction flour), and semolina etc. In Pakistan wheat is a leading grain crop and is principal food for the people who live there and consumed as chapattis or rotis to attain their cheapest caloric and protein requirement (Anonymous, 2010; Anjum*et al.,* 1991).

The major cause of this loss is the seed born fungi called 'Mycotoxin'. These toxins are environmentally stable and resistant towards thermal changes (Scudamore, 2005), and can cause problem in grain storage, because of many important factors like moisture content, temperature, storage period, contamination rate, broken grain and impurities, insect presence, oxygen rate, damages during harvest processing and grain and seed transport (Lazzari, 1997; Scussel, 2002; Santos, 2002; Garcia *et al.,* 2003; Scudamore, 2005).

Mud bins, metallic bins, concrete rooms, jute bags and wooden boxes are used at farms for storage of grains and whole sellers practice open storage where bags of grain was positioned on plinth and covered under tarpaulin sheet (Baloch and Irshad, 1986). Post-harvest losses are quite considerable due to deprived of drying and storage facilities. In Pakistan it is estimated that 15% of wheat loss occur annually (Chaudhary, 1980). In numerous parts of the world, grain quality protection is a serious issue during storage (Gras *et al.,* 2000), and situation went worse with each increasing day. Fusarium culmorum in endosperm of infected wheat grain was found to produce cell wall demeaning enzymes i-e amylases that break down the storage compounds in endosperm and Fusarium also found to involved in extracellular hydrolytic enzymes and phytotoxic compounds production (Jackowiak *et al.,* 2005). Fusarium germanium also produce this type of destruction in grains (Nightingale *et al.,* 1999; Schwarz, 2003), different types of damages after mycotoxin production was detected in oat endosperm cells composed of starch granules (Packa, 2005). Physico-chemical properties were effected through mycotoxin contamination load (Embaby *et al.,* 2012).

Having collected broad investigational materials, the study was launched to assess the different fungi that

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produce mycotoxin and also to explore damage to the wheat kernels and its possessions on quality of wheat during storage in the common storage houses (godowns) at Pakistan.

2, MATERIAL AND METHODS

Wheat samples was collected from all government godowns of Hyderabad division namely Bolhari, Hali road, Fatah chowk, Hala city, Matiyaari, Thatta, Tandpallhyaar, Dadu, K.N shah, Sehwan and Aarazi. Sampling was done form upper, central and bottom sacks of one selected stack after seven months of wheat storage at godowns. During sampling temperature was recorded 37-52°C and moisture of all godowns were in the range of 40-70%.For physico-chemical analysis wheat grain samples was subject to instrument on normal base moisture of grain without any treatment.

Mycological Study

Mycoflora was determined by the method of agar plate described by Mathur *et al.* (2003) Whereas relative isolation frequency (Fq.) of fungi (*Aspergillus parasiticus and Aspargillusflavus*) that produce mycotoxins was calculated (Bensassi, *et al*., 2011).

2. RESULTS AND DISCUSSION

Mycological examination of stored wheat grainmycotoxin is a problem in many commodities therefore examination of wheat quality is of great importance in food and feed, they come from the field during the growth, after harvest when wheat is stored in godowns the fungi colonize under favourable conditions due to improper storage, produce certain type of mycotoxin and make grain quality protection is a serious issue during storage globally (Gras *et al.,* 2000).**(Fig. 1)**showed all the mycotoxin producing fungi colonize during storage with increasing time.

Frequency percentage of mycotoxin producing fungi were calculated at different times, May, July and October; and higher frequency percentage was found in the month of October during storage time. The present results are consistent with Birck, *et al*., (2003) reported 96.7% wheat was contaminated with *Aspergillus spp*. in the storage period of 180 days after being harvested. Further data was supported by Rajarajan *et al.,* (2013) studied peanuts from Madurai godown and found peanuts are highly contaminated with aflatoxin producing fungi *A. flavus*. Results in Fig. 8 shows that among every sampling time from a selected stack, the bottom portion gives a higher percentage of frequency of *A. parasiticus* and *A. Flavus* as the aflatoxin producing fungi are infavorable conditions, therefore it is said that the portion matters in the storage this was also supported by the Birck, *et al*. (2003) that in the wheat of middle portion of silos produce more aflatoxin producing fungi.

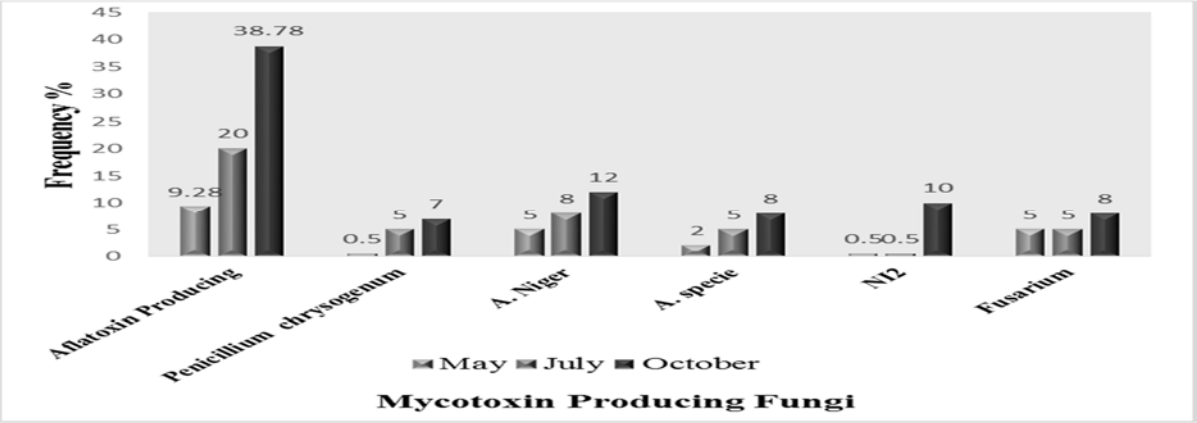


Fig.1. Average of Frequency % of Mycotoxin producing Fungi in different sampling months.

Aflatoxin Producing fungi (F= 1.5, P=0.2, df = 8)
***Penicilliumchyrsogenum* (F= 1.6, P=0.2, df = 8)**
***Aspergillus Niger* (F= 1.7, P=0.2, df = 8)**
***Aspergillus specie* (F= 1.7, P=0.2, df = 8)**
Not identified 2 *(F= 1.6, P=0.2, df = 8)*
***Fusarium* (F= 1.9, P=0.2, df = 8)**

Impacts on physico-chemical properties of wheat due to mycotoxin Wheat (*Triticumaestivum*) is the main diet for the people of Pakistan and is a main nutrient for energy and protein, also it is the main cereal produced and consumed in Pakistan. Globally, wheat is a primary food, consumed in the form of bread, biscuits etc. (Economic survey 2000-2001). Therefore the protein, starch and hardness assessment is an important parameter in this regard.

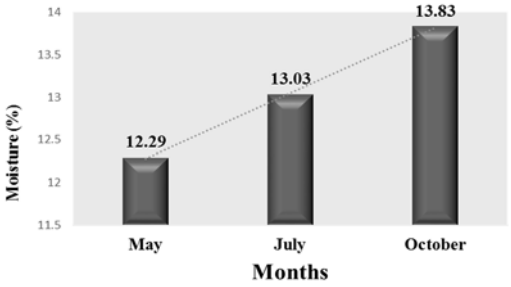
Present data reveals that the moisture content found increased in stored wheat grain whereas starch content becomes low in wheat stored in god owns the storage time increases due to increased colonies of moulds that deteriorating starch and also the hardness of wheat is lost during the storage due to the increase in relative humidity which directly rises the moisture (%) of the grain thatin turn decreases the hardness and become a important factor to increases mould colonization.

The **(Fig. 2)** reveal that moisture was noted to increase as the grain storage time was increasesas the Moisture has effect on grinding time of wheat (Williams *et al.,* 1998). High moisture content enhances proteolytic and lipolytic activities leading to loss of nutrients (Jafri, 2010). Similar statement given by Anjum *et al*.,1991 that storage time and yield of flour decreases due to increased amount of moisture content in wheat grains. Wheat kernel texture is also known to be affected due to presence of moisture, that also helps to measure wheat kernel weight (Pomeranz and Williams, 1990). Due to climatic and agronomic conditions moisture content shows variations in wheat grain during growth period and genetic make-up of grains (Mahmood, 2004).

The important criterion for assessing wheat quality is protein content. It is reported that difference in protein content among different wheat, could be due to genotype, environment and the growing conditions (Kent, 1983; Gupta *et al.,* 1993).

Belderok *et al;* reported that Starch is the stored energy of cereals grain. The amount of starch in a wheat grain vary between (60-70%). Starch present in wheat forms the gels and when gel formed the viscosity increases sufficiently, this is a useful functional property of starch as it is useful in food appliances as gels act as a matrix for holding water, lipids, sugars, flavors, and other ingredients in new product development(Belderok *et al.,*2000).

Hardness is the important factor that improves the quality of wheat grain, Endosperm texture (Hardness) in wheat is the single most important and defining quality characteristic, as it facilitates wheat classification and affects milling, baking and end-use quality and wheat hardness is also an important milling quality descriptor, according to which wheat is divided into soft, hard, and durum wheat (weightman *et al*., 2008; Pasha *et al.,* 2010).



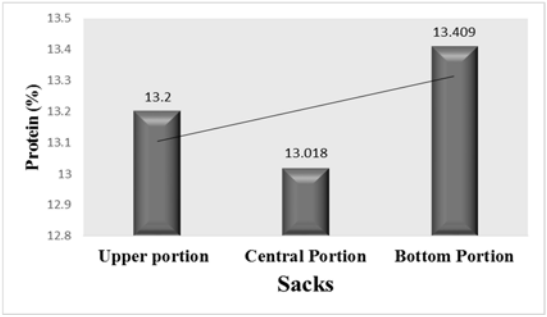
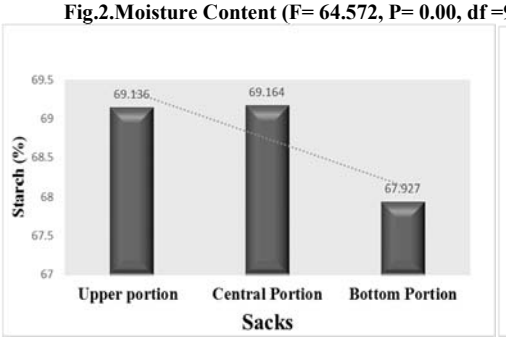


Fig.2.Moisture Content (F= 64.572, P= 0.00, df =98).Fig. 3. Protein % (F= 1.007, P=0.377, df = 32);



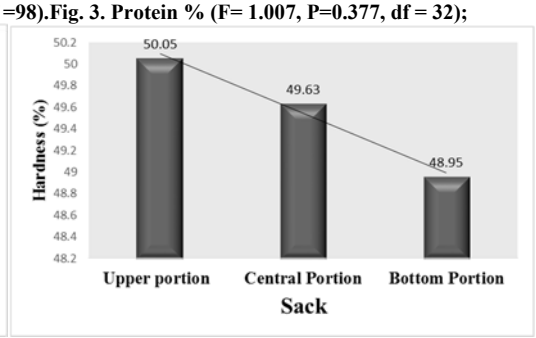


Fig.4. Starch % (F= 6.448, P=0.005, df = 32) Fig. 5. Hardness % (F= 1.368, P=0.270, df = 32)

3. CONCLUSION

It was sum up from current research that wheat after a long storage time, that is in month of October, from bottom sack contained high concentration of fungi that produce mycotoxins. The change in temperature and moisture during storage becomes advantageous for the fungi to produce their toxins, as increase moisture content having a direct proportionality with moulds colonization, Moreover Physico-chemical analysis showed that godown samples having low starch content due to more deterioration, and the hardness is also reduced due to an increase in moisture during storage which help to risesfungi level to produce their respective toxins.

REFERENCES:

Anjum, F. M., A Ali and N. M. Chaudhry (1991). Fatty acid, mineral composition and functional (bread and chapati) properties of high protein and high lysine barley line. J. Sci. Food and Agric.55; 511-519.

Breiman, A. and D. Graur, (1995). "Wheat evaluation." Israel J Plant Sci. 43:58-95.

Baloch, U. K. and M. Irshad. (1986). Post-harvest research on food grains in Pakistan: A review. FAO / PARC Report, Islamabad

Belderok, B., H. Mesdag and D. A. Donner. (2000). Bread-Making Quality of Wheat. Springer, New York.

Birck N. M., M I, Lorini, V. M Scussel. (2003). Fungus and mycotoxins in wheat grain at post harvest. 9th International Working Conference on Stored Product Protection, center for Agricultural sciences and technology. PS2-12 – 6281.198 – 205

Embaby E. M, M Nahed, N. H. Ayaat, El-Hamid A. M Mona, A. A Abdel-Galil, Yaseen, Marwa, A Younos. (2012). Detection of Fungi and Mycotoxin Affected Wheat Quality. J. Applied Sci Res., 8: 3382-3392.

Farooq, Z., S. Rehman, M. S Butt and M.Q. Bilal (2001). Suitability of wheat varieties/ lines for the production of leavened flat bread (naan). J. Res. Sci. 12 (2): 171-179.

Fatma B., M. Chennaoui, and R.H. Mohamed. (2011). Survey of the mycobiota of freshly harvested wheat grains in the main production areas of Tunisia. African Journal of Food Science, 5(5): 292- 298.

Garcia, M. J, de M. Biaggioni, M. A. M, Ferreira E. Y. Almeida (2003). Sucessão de espécies de fungosemmilhoarmazenadoem Sistema aerado. Revista Brasileira de Armazenagem., 27: 14-22.

Gras P. W., S. Kaur D. A. Lewis B. O. Riordan (2000). How and why to keep wheat quality constant. In: Australian Post Harvest Conference, 195-198.

Gupta, R.B and K. W. Shepherd. (1993) Production of multiple wheat-rye 1RS translocation stocks and genetic analysis of LMW subunits of glutenin and gliadins in wheats using these stocks, Theor. Appl. Genet., 85 719-728.

Jackowiak, H., D. Packa, M. Wiwart and J .Perkowski. (2005). Scanning electron microscopy of Fusarium damaged kernels of spring wheat. International Journal of Food Microbiology, 98(2): 113-123.

Khan, I. and A. J. Zeb. (2007).Nutritional composition of Pakistani wheat varieties* Zhejiang Univ. Sci., 8:8 555-559

Kent, W. L. (1983). Technology of Cereal. Pergamon, Headington Hill Hall, Oxford UK, 49-60.

Mahmood, A., Ph.D. Thesis. (2004). Inst. Food Sci. Technol. Univ. Agric. Faisalabad, Pakistan

Mathur, S. B and O. Kongsdul, (2003). Common Laboratory seed healthy testing methods for detecting Fungi ,Danish Government Institute of Seed Pathology for Developing Countries Thorvaldsensvey57, DK-1871 Frederiksberg C, Copenhagen, Denmark. 399

Meyer D., D. Weipert, H. Mielke (1986). Effects of Fusarium culmorum infection on wheat quality. GetreideMehl und Brot, 40: 35–39.

Nightingale M J., R M. Clear (1999). Fusarium head blight: effect of fungal proteases on wheat storage proteins. Cereal Chemistry 76, 1: 150–158.

Pomeranz, Y. P. C. Y(ed.), Williams, (1990) Pomeranz Advances in Cereal Science and Technology, St Paul, MN: AACCI, 10 471

Rajarajan P. N, K.M, Rajasekaran, N. K. Devi (2013). Isolation and Quantification of Aflatoxin from Aspergillus flavus Infected Stored Peanuts. Indian J. Pharm. Biol. Res., 1:76-80.

Santos. J. P. (2002)...Métodospreventivos de controle de pragas de grãosarmazenadosIn: Lorini, I., Miike, L.H., Scussel, M.V. (Eds), Armazenagem de grãos.Campinas, IBG, p. 399-441.

Schwarz, P. B**.** (2003). Impact of Fusarium head blight on malting and brewing quality of barley. In: Fusarium head blight of wheat and barley. Eds. K.J. Leonard, W.R. Bushnell. APS Press, St. Paul, MN: 395–419.

Scudamore K A. (2005). Identifying Mycotoxins is Paramount in the fight against their spread. Word Grain. 23: 36-39

United States Food and Drug Administration (US FDA), (2000). Action levels for poisonous or deleterious substances in human food and animal feed. (http://www.cfsan.fda.gov/_lrd/fdaact.html#a.a); Washington, DC.

Weightman, R. M., S. Millar, J. Alava, M. J. Foulkes, and J. W. Snape. (2008). J. Cereal Sci. 47 457-468.

Williams, P. C., J. Knight and J. Psotka. (1998). Application of the Perten SKCS-4100 single kernel characterization system to predict kernel texture on the particle size index. Cereal Foods World 43:550-562.