SOME CHEMICAL AND TECHNOLOGICAL CHANGES OF WHEAT GRAINS BY CERTAIN FUNGI IN STORAGE

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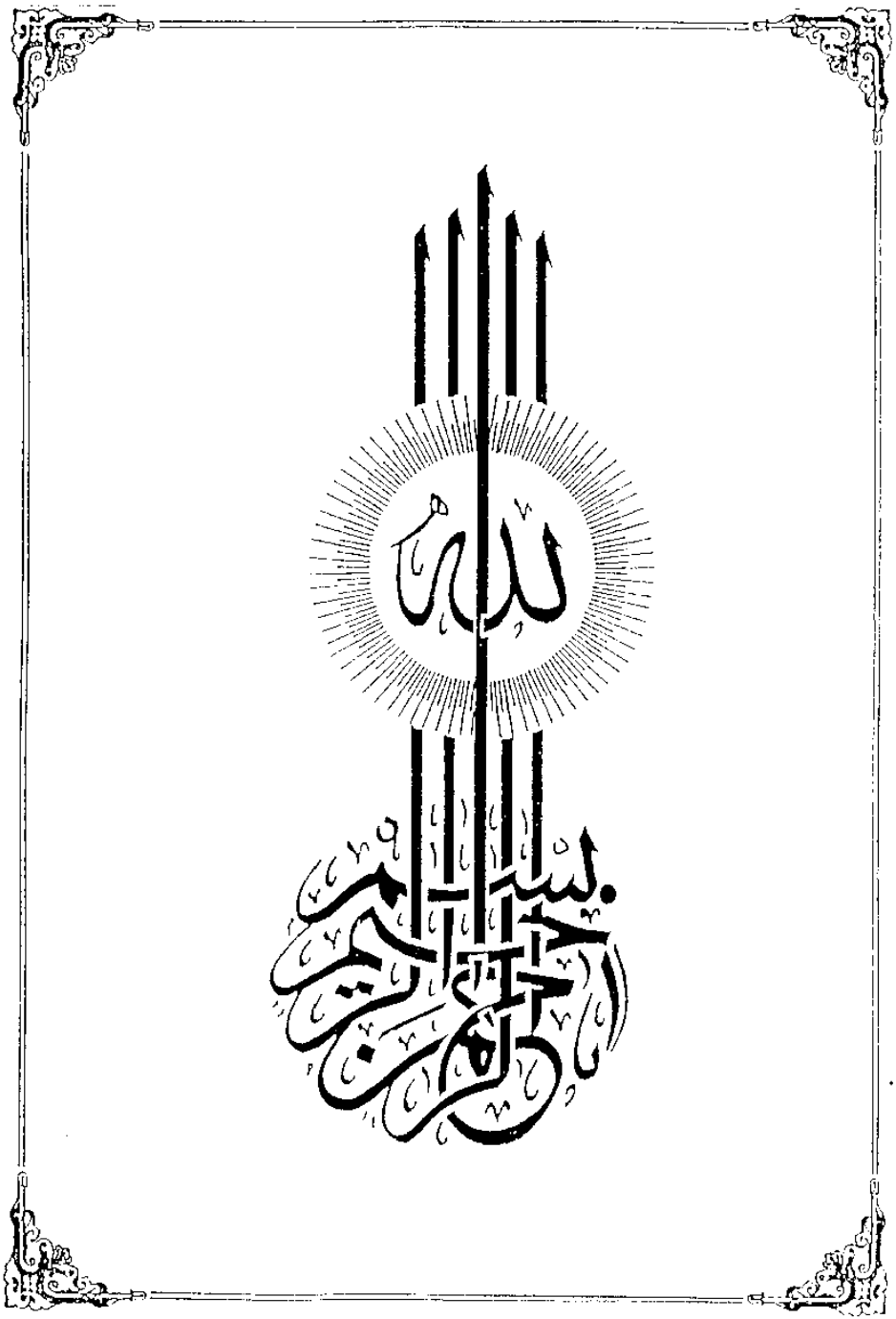

C O N T E N T S

A C K N O W L E D G M E N T

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I N T R O D U C T I O N

Wheat(Triticum vulgare) is considered as one of the most important crops in the world. Most of it is made into flour which is used for making different products. It is used principally as human food, animal feed, and also in some industries.

The cultivation of wheat extends upon large areas in the world. It is grown on about 532 millions of feddans. This area supplies about 250 millions of tons of wheat which represents approximately the world production of wheat grains. Table 1 indicates the area cultivated yearly with wheat and yield during recent years in the A.R.E.

Table (1) : Area and yield of wheat in the A.R.E.

Year	Area of wheat (feddan)	Yield (Ardab)	Mean (Ardab/feddan)
1972 *	1259335	10772343	8.69
1973 *	1247578	12246426	9.82
1974 *	1351339	12557661	9.17
1975 * *	1393150	13555099	9.72
1976 * *	1395588	13066636	9.36

* Anon(1975)

* * Ministry of Agriculture, ARE (Unpublished data).

The largest wheat producing countries are the USSR, U.S.A., China, Canada, France and India. Chief exporters include the U.S.A., USSR, Canada, Australia and Argentina (Wilsie, 1962).

The local yield is not sufficient for consumption. The shortage is compensated by importation.

In spite of the great progress in the cereal technology, large amount of grains are still lost owing to the deterioration and damage occurring during its improper storage. The world's loss of grain, pulses and oil seeds amounted to about 5 percent of that harvested (Kent Jones and Amos, 1967).

Storage of grains such as wheat, has a great importance from the economical point of view. The method of grain storage vary from small inexpensive farm type stell or wooden bins to elaborated systems involving mechanical ventilation, according to the different countries and its agricultural and economical developments. Recent researchs on grain storage have shown that moisture content of grains and temperature play the major role in safe storage.

It can now be taken for certainty that molds are responsible for the respiration, spontaneous heating,

chemical changes that occur in stored cereal grains at moisture content common in practice.

As far as the writer is aware, no attempt was tried for studying the problem of deterioration of wheat grains by fungi in Saudi Arabia.

The present investigation deals with studies on the effect of storage condition on the microbiological, chemical, and physical properties of a local variety Giza 155 and imported variety (Chenab). The latter which was recently distributed by means of the Ministry of Agriculture. Wheat grains were stored at 25, 35 and 45°C at a different levels of relative humidity i.e., 65, 75 and 85% up to six moths. Those selecting temperatures and relative humidities represent most of the area of A.R.E and Saudi Arabia.

The present work was carried out to investigate the following :

1 - Mold flora associated with commercially stored wheat grains.

2 - Identification and pathogenic capabilities of fungi that proved high frequency of occurrence.

3 - Studies on the changes in microbiological, chemical,

and physical properties of a local variety in comparison, with the imported variety. The study was planned to run for 6 months with interim sampling at month intervals.

REVIEW OF LITERATURE

Microflora of stored grains :

Koehler (1938), found that Aspergillus flavus Link, Aspergillus glaucus group, A. ochraceus, Wilhelm, A. niger V. Tiegh, A. versicolor (Vuill) Turaboschi, A. wentii, Wehmer, Cephalosporium acremonium Corda, Diploida zeae (Schw) Lev, Fusarium moniliform (Sheldeon) Snyd. and Hans; Fusarium graminearum Schw, Nigrospora oryzea (B. and Br.) Petch., Penicillium notatum Westling, and P. palitan Westering were commonly associatied with stored grains.

Christensen and Gordon (1948) found that the principal organisms on all wheat samples tested were species of Aspergillus such as Aspergillus glaucus group, Aspergillus candidus Link and Aspergillus ochraceus Wilhelm. Penicillium sp. while Aspergillus flavus Link was found occasionally in small numbers.

Christensen (1951) reported that fungi known to cause deterioration of moist stored wheat were found as dormant spores on the surface of the seed, and as dormant mycelium within the pericarp. Most of the living mycelium beneath pericarp were that of Aspergillus and Penicillium known to be involved in the deterioration of stored grains.

Semeniuk (1954) proposed that the microflora of cereal grains was consisted of wide varieties of fungi and bacteria . Bacteria did not normally appear to be involved in the deterioration of stored grains, because they required free water to grow and they were incapable of mechanically penetrating intact cereal grain tissues . Thus the deteriorative action of stored grains was principally a role of fungi. He added that the kind and abundance of fungi of stored grains depended principally on the condition prevailing during storage as moisture content, temperature, and period of storage .

Christensen (1955) found that Aspergillus restrictus invaded the grains of different wheats stored at moisture content 13.5 - 14.5% for 16 months. Strains of Aspergillus glaucus , Aspergillus repens (Corda) de Bary and Aspergillus ruber (Spieckerman and Bernner) Thom and Church, invaded grains stored at moisture content above 15%.

Christensen(1957) reported that fungi in seed might be divided into two groups, designated field fungi and storage fungi. The field fungi were those that invaded the developing or mature grain while it was still on the plant . The major genera were Alternaria Helminthosporum, Fusarium .

The storage fungi were those, which developed on or within seeds at moist condition, often encountered in storage principally Aspergillus and Penicillium. Aspersillus glaucus group, was one of the major fungi that invaded stored seeds. It invaded wheat at moisture content of 13.2 to 15% (wet weight bases), with increasing moisture content above 15%, Aspergillus candidus Link, Aspergillus ochraceus Wilhelm., A. tamarii Kito and perhaps few other species of Aspergillus and Penicillium appeared to be involved in the deterioration of stored wheat grain.

Tuite and Christensen (1957) found that the storage fungi did not invade grain to any appreciable degree of extent before harvest. The same result was obtained by Tuite (1961).

Asawar and El-Arosi (1961), reported that Aspergillus niger V. Tieg., Aspergillus nidulans (Eidam) Wint; Penicillium italicum Stoll; Rhizopus nigricans Ehrenb. and Mucor sp. were recorded at high frequency among the total fungi isolated from wheat grains stored for 9-12 months when plated on PDA. The frequency of Curvularia sp., Aspergillus flavus Link, Alternaria sp. Cladosporium sp. Clindrocarpon sp. Chaetomium sp. Fusarium oxysporium Schlecth and Fusarium sp. was quite low.

Christensen and Kaufmann (1965), Proposed that the storage fungi were those which developed on and within seeds at moisture contents often encountered in storage, principally Aspergillus and Penicillium . They did not invade grains to any appreciable degree before harvest .

Sirry et al. (1973 b); reported that Aspergillus fumigatus Fresenius, Aspergillus flavus Link, Aspergillus ochraceus Wilhelm and Penicillium chryspgenum Thom were in revealed higher frequency and percentage of occurrence, than any ather fungi.

Factors Influencing Deterioration Cherges :

1. Moisture :

Barton and Tomking (1945), recorded tnat storing wheat at relative humidities of not more than 80% were advisable to eliminate mold growth .

Zeleny (1954), reported that if the moisture content was maintained at a sufficient low level, grains could be stored for many years with little deteroration even under conditions tnat otherwise were unfavourable .

According to Hummel et al. (1954), the critical moisture value of microbiological development in the whole was at a moisture content that corresponded to a relative humidity of 75%.Only at this moisture and higher could the

molds develop in and on the wheat.

Sorger Domenigg et al. (1955) reported that the mold count decreased when samples of wheat were stored at room temperature for up to 12 months, at 14% and 13% moisture content.

Christensen (1955) observed that A. restrictus invaded various wheat stored in the laboratory at moisture contents of 13.5 - 15.0% for 16 months. It appeared to develop more in the germ than in other parts of the seed. This fungus was prevalent in some commercially stored samples in which damaged wheat developed.

Tuite and Christensen (1957) found that at moisture content of 13.0 - 13.6 wheat seeds were invaded gradually by A. restirictus, A.repens and A.ruber. At, moisture contents of 14.3 - 14.6% all species invaded 100% of the seeds within 4 months, and at moisture content of 15.6-16.0,100% of the seeds were invaded in one month.

Sauer and Christensen (1960) reported that hard spring and winter wheat differed only slightly in the degree to which they were invaded by fungi when held at moisture content near the lower limits (13%) that permited the fungi to grow.

Christensen (1964) recorded that samples of freshly

harvested durum wheat stored at moisture content at 13.4 to 13.6 and 25°C for 493 days were slowly invaded by A. nelophilus and A. restrictus but germination percent of the seed did not decrease.

2. Temperature :

Golubchuk et al. (1956) reported that the temperature of wheat grains during long storage increased the rate of development of germ damage and biochemical changes that contributed to decrease in quality .

Christonson and Kaufmann (1965) recorded that low temperature could be subtituted for high quality in stored grain, and the maintainance of a uniform temperature of 5 to 10°C throughout a bulk of grains, prevented shift in moisture and provided insurance against development of unexpected damage .

3. Time :

Milner et al. (1947), Milner and Geddes (1954) found the greater the deterioration of grains correlating longer time of storage . Hummel et al. (1954), Berger Domenigg et al .(1955) Golubchuk et al . (1956), Papavizas and Christensen(1960),Kennday(1964),Saure and Christensen(1966) Ashour et al (1970)reported that great deterioration of wheat grains