A STUDY OF THE RELATIONSHIP BETWEEN THE RELATIVE HUMIDITY AND EQUILIBRIUM MOISTURE CONTENT OF HARD AND SOFF WHEAT

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Introduction

Today, as the number of people rises faster than ever, particularly in the developing countries, the problem of producing enough food is becoming even more acute.

On the other hand because of many different defects, such as changing of some agricultural countries to industrial countries, migration of farmers from the villages to the cities, erosion of the soil and many other reasons, every year the sources of food become less and less.

The importance of these problems are to the extent that many governments and also different international organisations are anxious about the future of mankind and try to find out a suitable way to solve the most important problem that has never faced it before.

Research about controlling population of the world, finding new resources of food even in the depths of the sea or on the other planets, planning new agricultural projects, controlling diseases and pests and so on, are some of the works that scientists hope may help them to solve this problem.

As we know, every year millions of tons of food are infested and damaged by the pests and diseases and at the same time many people starve in different parts of the world, so that there is no doubt that one of the most important ways for producing more food is protecting all the agricultural products from infestation and damage.

In spite of the fact that all the pests and diseases are important it is acceptable that the storage pests and rodents are more important in this problem, because they damage the main food of the people such as wheat, rice, maiz, barley and other crops and grains. Contrary to other pests which are local and seasonal, the storage pests and rodents damage all agricultural commodities all around the world and at all times of the year; also, from the economic point of view the storage pests and rodents damage the products when all the expenses from cultivation to harvest have been paid, and the commodities are ready for use. Finally rodents (rats and mice) are very dangerous to hygiene of the people because of spreading many diseases.

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Materials and Methods of the study

About 1.2 kg of hard wheat was placed in Kilner jars and shaken occasionally over a period of one week to reach a uniform equilibrium moisture content. A sample of about 15 gms was milled in the Regent Maskiner grinder and divided into three 5 gm replicates in special aluminium tins weighing about 6 gms. The moisture content was determined by heating in a fan-ventilated oven at 130°C for one hour. The tins were weighed empty, then with the samples before and after heating. The initial moisture content was found to be 12.6%. It was decided to produce samples at two different moisture contents, 7% and 20%, by drying and wetting. The 1.2 kg of wheat was divided into two 600 gms samples. The first was dried in the oven for 22 hours at 40°C and the second was conditioned by adding and mixing a calculated wight of water, about 55.5 cc according to the following equation:

$$W = \frac{W1\ (A-B)}{100-B}$$

w = weight of water to be added

W1 = initial weight of sample

A = initial moisture content

B = final moisture content

n this experiment W1 = 600 A = 12.6 B = 20

$$W = \frac{600\ (12.6-20)}{100-20} = 55.5$$

The two samples were put in a refrigerator (to avoid mould growth) and shaken daily for a week to give the grain a uniform moisture content. After about one week samples were tested using the oven method on three replicates. The final moisture content of the dry sample was 6.7% and the wet 19.4%.

Two sets of five desiccators were prepared, each desiccator containing a saturated salt solution, the salts used were: potassium carbonate (K_2C0_3); sodium bromide (NaBr); sodium nitrite ($NaNo_2$); sodium chloride (Na Cl) and potassium chloride (K Cl); giving relative humidities of 43, 58, 65, 75 and 85 per cent respective at 27°C.

In one case potassium iodide (KI) was used instead of sodium nitrite so that the relative humidity was 69% in this instance.

Five sub-samples each of 60 gm were taken from each 600 gm sample and placed in desiccators. The desiccators were transferred to a constant temperature room at 27°C. The sub-samples were left in the CT room for 40 days. At the end of this time about 20 gms were taken from each sub-sample and the moisture contents were determined using the oven method. The results were as follows:-

Isotherm	Initial mc %	Relative Humidity					
		43	58	65	69	75	85
Sorption	6.7	9.6	11	11.9	—	13.8	16.1
Desorption	19.4	11.1	11.9	—	13.8	14.5	16.7

The remainder of the samples were left for a further 20 days. Then the moisture content was determined again to check that equilibration had indeed occurred in the first 40 days period.

From the results obtained the moisture content/relative humiity curves at 27°C were plotted (Fig 1). The same study was made on soft wheat at 7.8% and 19.3% moisture content.

All results are given in graph form and tables:

Hard wheat; Figure 1 and Table 1

Soft wheat; Figure 2 and Table 2

At the 65% rh points in Figure 2 the moisture content readings are apparently low by up to 0.5%. This was probably due to the fact that some grain was spilt from the sample into the salt solution. This occurred when it was necessary to remove all the samples for cleaning of the CT Room. The grains floating in the salt lowered the humidity over the solution.

Table 1. Equilibrium moisture content of hard wheat at the relative humidity shown after 40 and 60 days and the average of the 40 and 60 days values

Isotherm	Initial moisture content %	Duration of test	Relative humidity 43	58	65	69	75	85
Sorption	6.7	40 days	9.6	11.0	11.9	—	13.8	16.1
		60 days	9.5	11.2	12.0	—	14.0	16.2
		Average	9.6	11.1	12.0	—	13.9	16.2
Desorption	19.4	40 days	11.1	11.9	—	13.8	14.5	16.7
		60 days	10.7	11.7	—	13.7	14.9	16.6
		Average	10.9	11.8	—	13.8	14.7	16.7

Table 2. Equilibrium moisture content of soft wheat at the relative humidity shown after 38 and 60 days and the average of the 38 and 60 days values

	Initial moisture content %	Duration of test	Relative humidity 43	53	65	75	85
Sorption	7.8	38 days	10.2	11.0	12.3	14.2	15.7
		60 days	9.9	10.9	11.9	13.9	16.2
		Average	10.0	11.0	12.1	14.1	16.0
Desorption	10.3	38 days	11.0	12.2	13.0	15.3	16.6
		60 days	10.5	11.7	12.8	14.8	16.6
		Average	10.8	12.0	12.9	15.0	16.6

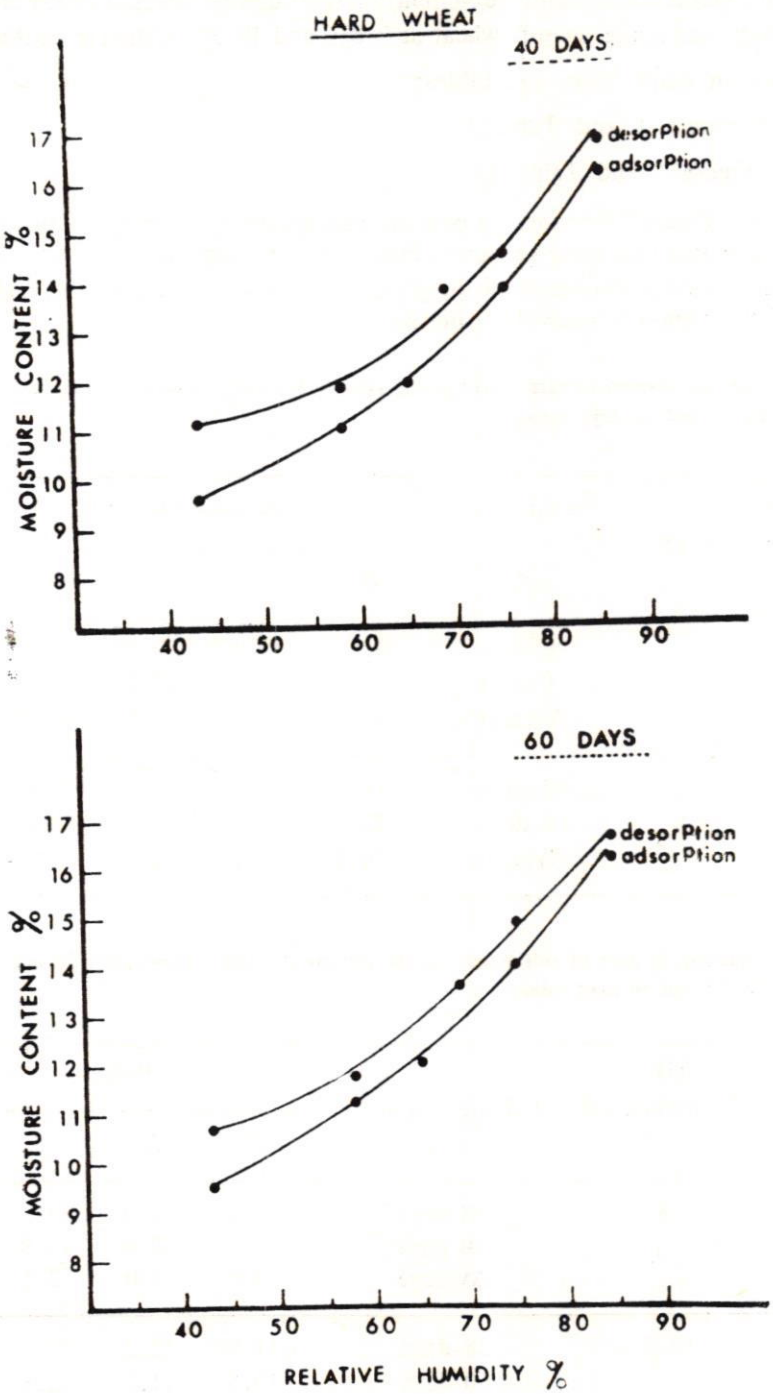

Fig. 1 Moisture content/relative humidity equilibrium of hard wheat at 27°C, showing desorption and adsorption curves

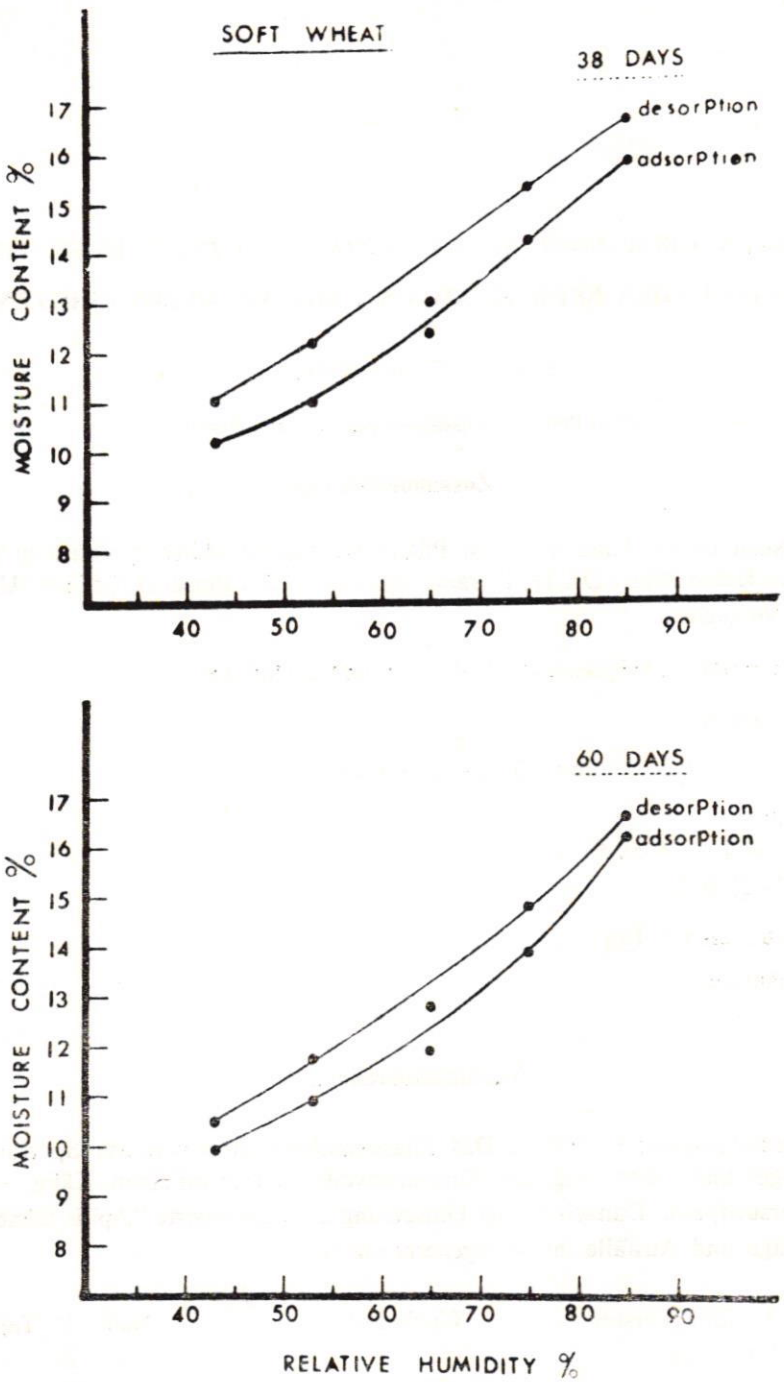

Fig. 2 Moisture content/relativ humidity equilibrium of soft wheat at 27°C, showing desorption and adsorption curves.