

## SATURATION MOISTURE CONTENT OF KODO (*PASPALUM SCROBICULATUM* L.) MILLET AND ITS DEPENDENCE ON TEMPERATURE AND DURATION OF SOAKING

B. S. SHIRSAT\* AND S. D. KULKARNI<sup>1</sup>

\*Department of Agricultural Engineering, College of Agriculture, Dr. B.S.K.K.V., Dapoli – 415 712 Dist- Ratnagiri (MS)

<sup>1</sup> Soybean Processing and Utilization Centre, Central Institute of Agricultural Engineering, Bhopal - 462038

\*E-mail: bhawnashirsat@rediffmail.com

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**ABSTRACT:** Soaking studies were conducted at different soaking temperatures and durations. The rate of moisture absorption in the initial stage of soaking was found to be maximum for all the sets of experimental conditions. It was found that the saturation moisture content for all the soaking temperatures except 80°C, was 71 per cent within the limit of this study. At 80°C gelatinization of starch took place at longer duration. Data obtained is useful in deciding the parameters for processing of 'kodo' millet.

**Keywords:** *Kodo* millet, *Paspalum scrobiculatum*, Saturation moisture content.

### INTRODUCTION :

*Kodo* (*Paspalum scrobiculatum* L.) millet is the staple food in the tribal belts of Madhya Pradesh and other states (Sharma and Mandhyan, 1992). The kernel of *kodo* has layer of husk at surface. It is required to be removed, as it is difficult to digest. Processing of '*kodo*' millet, therefore, assumes significance. The total production of small millets in India was 0.66 million tones in the year 2001 and major *kodo* producing states are Madhya Pradesh, Chhattisgarh, Maharashtra, Karnataka, Tamil Nadu and Uttar Pradesh. *Kodo* is a good source of protein, carbohydrate and rich source of minerals, fibers, vitamins and micronutrients (Asgar and Manorama, 2003).

In tribal areas, the husk of *kodo* is removed by hand pounding. The average value of actual husk content was obtained to be 20.56%. It is very laborious and time-consuming process. A day's work may lead to dehusking of 5-6 kg dehusked *kodo*. Soaking was considered as a base step in *kodo* processing. The present investigation was undertaken to study the effect of temperature and soaking time on rate of moisture absorption. The rate of moisture absorption during soaking plays an important role in reducing the soaking time. To determine proper duration of soaking to achieve desired level of moisture content, the knowledge of saturation moisture content value is essential, which indicates the upper limit of moisture absorption by particular grain without any physico-chemical change in the material by Kulkarni (1986). The rate of moisture uptake by the grain is directly proportional to the difference of saturation moisture content and the moisture content of the grains at any given time i.e.,

$$\frac{dM}{d\theta} \propto (M_s - M) \quad \text{or} \quad \frac{dM}{d\theta} = \beta (M_s - M)$$

$$\text{When, } \frac{dM}{d\theta} = 0, M_s = M$$

### MATERIALS AND METHODS

A known weight (25g) of *kodo* millet at initial moisture content of 13.47 %(db) was taken in a beaker and 75ml of hot water (100°C) was added to it. This beaker was then placed in the water bath maintained at the desired temperature retained in the water bath for a decided duration and temperatures. Study was conducted at soaking water temperature of 40, 50, 60, 70 and 80°C and soaking duration of 30, 60, 90, 120, 180, 240, 300 and 360 min. After completion of soaking process, the water was drained and the grain surface moisture removed using blotting paper. The moisture content of the soaked sample was then determined by standard hot air oven method by Ranganna (1995) and presented on % dry basis. The rates of moisture absorption values were computed from soaking test data analyzed and presented for center point of soaking duration. used for determination of saturation moisture content.

### RESULTS AND DISCUSSIONS :

**Moisture Absorption:** It is clear from (Fig. 1) that there is sudden rise in moisture content at initial stage of soaking at all the temperatures. This might be due to sudden filling up of the space between the husk and kernel. The effect of soaking temperatures can also be seen that as the soaking temperature increased the moisture content increased. The distinct shift in moisture curve for soaking temperature of 80°C at duration of 120 min. This clearly indicates the initiation of gelatinization of starch. Fast increase in moisture content after 120 min of soaking duration indicates the cooking of *kodo* millet. Close observation of sample confirmed the cooking of sample.

**Rate of moisture absorption:** The variation in the rate of moisture absorption at different intervals during soaking at various temperatures (Fig. 2) shows that the rate of moisture absorption was maximum in the initial stage of soaking for all the temperatures. Initial rate of moisture absorption was higher for samples soaked at higher temperature and maximum for 80°C for given initial moisture content of the

sample. It ranged from 0.7 to 1.49 % db per min at the beginning of soaking i.e. at 15 min soaking time. It was also observed that the rate of moisture absorption decreased with increase in soaking duration and reached to almost zero after 3.5 hours. However, in case of 80°C this trend was not seen and after soaking for 2hrs and the rate of moisture absorption suddenly increased (Fig 2). The sharp increase in moisture content after 2h of soaking at 80°C temperature due to gelatinization of starch and thereby initiation of cooking *kodo* kernel at higher temperature. This demands restricting the hydration process to 2 hours of soaking at 80°C, if gelatinization of starch was not the target of pre-treatment.

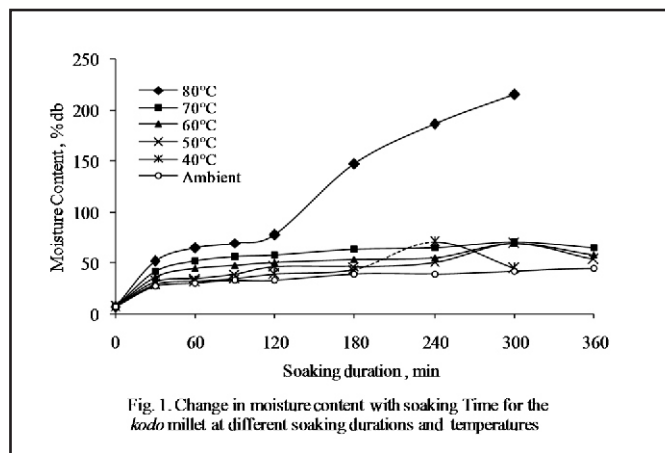


Fig. 1. Change in moisture content with soaking Time for the *kodo* millet at different soaking durations and temperatures

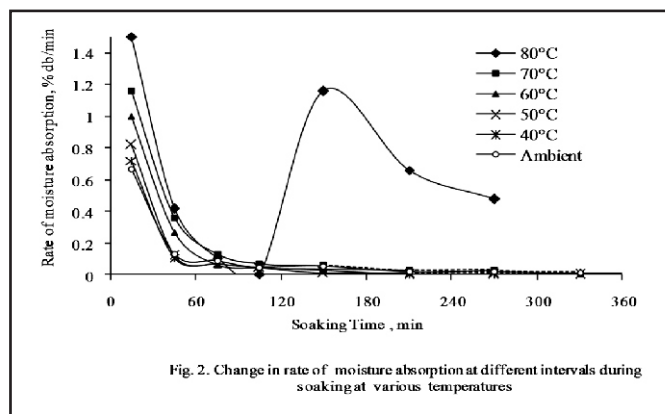


Fig. 2. Change in rate of moisture absorption at different intervals during soaking at various temperatures

**Saturation Moisture Content :** The moisture content of the materials when it is in equilibrium with the surrounding atmosphere under given conditions- indicates the upper limit of moisture absorption without any physico- chemical changes in the material. It was determined using equations developed by Kulkarni and Bal (1991) i.e.,

$$M = M_s \text{ at } \frac{dM}{d\theta} = 0$$

To achieve the saturation moisture of the grains, the moisture absorption rate was plotted against the moisture content at respective soaking duration and for different soaking temperatures (Fig.3). The value of saturation moisture,  $M_s$  was determined from the hydration data obtained for different soaking temperatures, viz, room temperature (34°C), 40,50,60 and 70°C and obtained to be as 71 per cent db. At 80°C soaking

temperature, after 2hrs soaking, the rate of moisture absorption increased due to initiation of cooking and gelatinization of starch at higher temperature. This indicated that the gelatinization temperature of *kodo* is likely to be some where between 70 and 80°C. This may be confirmed by conducting the experiment with smaller interval of soaking temperature. In addition to this, due to swelling of grains during cooking, the cracks also appeared on hulls (pericarp) of the grains soaked at 80°C for beyond two hours soaking duration. These also contributed for higher absorption rate of moisture. This may be due to the fact that the temperature is only a factor, which can reduce the soaking time for achieving the level of saturation moisture. Thus, soaking time to achieve  $M_s$  would vary as per soaking temperature, and be more for low temperature soaking and vice versa. The data for 80°C was not considered for estimation of saturation moisture content.

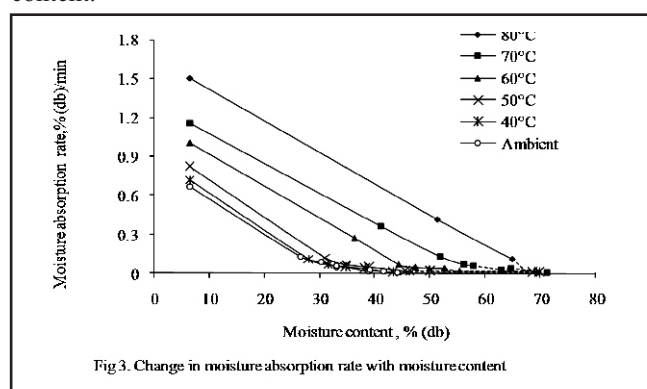


Fig.3. Change in moisture absorption rate with moisture content

## CONCLUSION :

The moisture absorption was higher at initial stage of soaking up to 60 min of soaking at all temperatures beyond which the increase in moisture content was not appreciated except at 80°C. A sharp increase in the moisture content after 120 min was visualized at 80°C. This is due to bursting of the husk and initiation of cooking process. The rate of moisture absorption decreased with the increase in soaking period for the temperatures below 70 °C but at 80 °C after 120 min. it is increased.

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