



P-ISSN: 2349-8528
 E-ISSN: 2321-4902
 IJCS 2020; 8(1): 2894-2897
www.chemijournal.com
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 Received: 16-11-2019
 Accepted: 18-12-2019

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Effect of soaking time on water absorption behavior of dehulled soybean dhal

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i1ar.8710>

Abstract

The effect of soaking time on water absorption behavior of dehulled soybean dhal (variety-JS-335) was studied at the Department of Agricultural Process Engineering, CAET, Parbhani to see the variation of water content (gm), moisture content (% , d.b.) and water absorption(%). Samples of soybean dhal (20gm) were soaked in water in the ratio of 1:3(w/v) at 15 °C, 25 °C and 35 °C water temperatures up to saturation point. During this experiment the amount of absorbed water increased as soaking time and temperature increased. During soybean hydration, the water is absorbed to a maximum of 140.78% in 4 hours, 3 hours and 2 hours at 15 °C, 25 °C and 35 °C, respectively. Initial water uptake was high due to high water concentration gradient between the soaking medium and dry cotyledons of the seeds. However, the rate of water absorption steadily decreased as the soaking process continued.

Keywords: Soya paneer, hydration, water concentration gradient

Introduction

Soybean is a leguminous crop and rich in proteins. Soybeans and soyfoods potentially have multifaceted health-promoting effects including cholesterol reduction, improved vascular health, preserved bone mineral density and reduction of menopausal symptoms. Many value added products are made from it like milk, sauce, soy flour, soy nuggets, paneer etc. Soypaneer (tofu) is a high protein soy product widely consumed all over the world. Tofu is low in calories, rich in essential amino acids, contains beneficial amounts of iron and has no saturated fat or cholesterol. Tofu has a great potential in the country as it is liked by many people. Tofu making processes generally include soaking and grinding of soybeans in water, filtering, boiling and coagulation of soymilk, and molding and pressing of bean curds. Nine processing factors had been found to influence tofu yield and quality: 1) the water to soybean ratio, 2) the soaking time and temperature of the soybeans, 3) the grinding process, 4) heat processing and the heating rate, 5) the stirring speed at various points in the process, 6) the coagulation temperature, 7) the type and concentration of the coagulants, 8) method of adding the coagulant to the soymilk, and 9) the weight and time of press of the curds (Wang and Chang, 1995) ^[10]. Hence the present research work was carried out to study the effect of soaking time on water absorption behavior of dehulled soybean dhal which would consequently affect the yield and quality of soypaneer.

Materials and Methods

Materials

Well graded JS-335 soybean variety was procured from Seed Processing Plant, VNMKV, Parbhani (Maharashtra). Dehulled soybean dhal was used in the experiment. The dhal was manually sorted by removing broken seeds and stones before soaking.

Soybean soaking process

Samples of dehulled soybean dhal (20gm) were soaked in water in the ratio of 1:3(w/v) at 15 °C, 25 °C and 35 °C up to saturation point. Three replications were taken for each soaking time.

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Determination of soaking characteristics

1. Weight of soaked sample

The weight of soaked sample were taken after every 15 minutes interval. The samples were drained before weighing.

2. Water absorption (%): The hydration process was analyzed in terms of percentage water absorption. (Munu, *et.al.* 2016) ^[6]

Percentage water absorption was calculated as-

$$\% W = \frac{W_f - W_0}{W_0} \times 100$$

Where,

% W = Percentage water absorption

W_f = Soybean weight after soaking, gm

W_0 = Soybean weight before soaking, gm

3. Moisture content (% , d.b.)

Moisture content was calculated as-

$$M (\% , d.b.) = \frac{100 m}{100 - m}$$

Where,

M = % moisture content on dry basis

m = % moisture content on wet basis

Results and Discussion

Soaking characteristics of dehulled soybean dhal at 15 °C, 25 °C and 35 °C water temperatures are shown in Table 1.

Table 1: Effect of soaking time on soaked weight of dehulled soybean dhal

Soaking time(min)	Soaked weight (gm)		
	15°C	25°C	35°C
0	20	20	20
15	28.35	28.5	32.5
30	30.05	32	37.7
45	32.5	35.2	41.3
60 (1hr)	35.1	37.2	41.7
75	37.35	39.8	42.5
90	38.25	41.7	42.6
105	39.8	42	42.9
120 (2hr)	40.7	42.1	43.1
135	41.85	42.1	--
150	41.75	42.7	--
165	41.95	42.9	--
180 (3hr)	42.75	43.1	--
195	42.85	--	--
210	42.9	--	--
225	43.05	--	--
240 (4hr)	43.1	--	--

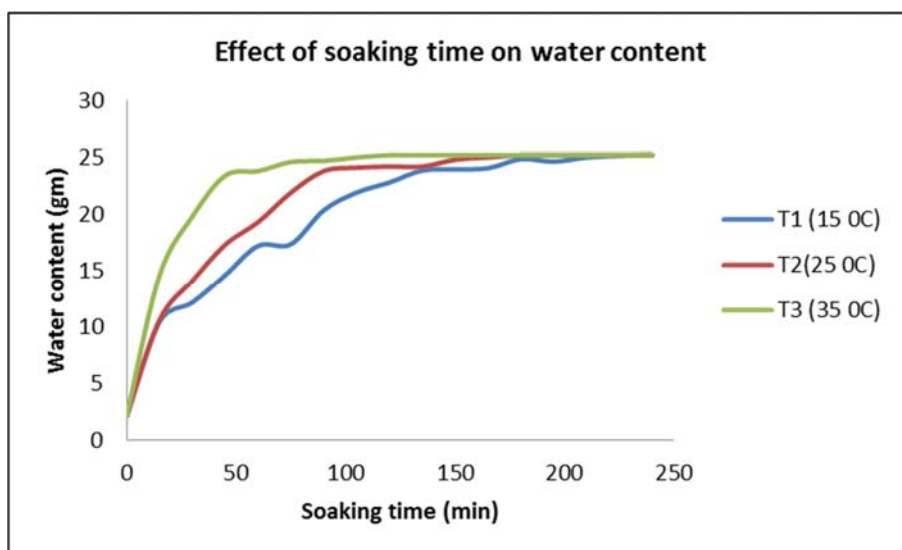


Fig. 1: Effect of soaking time on water content (gm) of dehulled soybean dhal

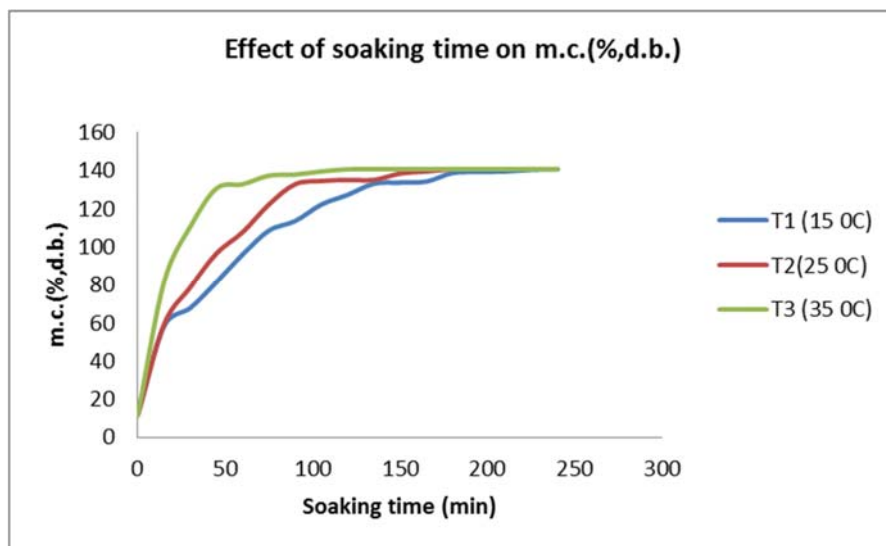


Fig. 2: Effect of soaking time on m.c. (% , d.b.) of dehulled soybean dhal

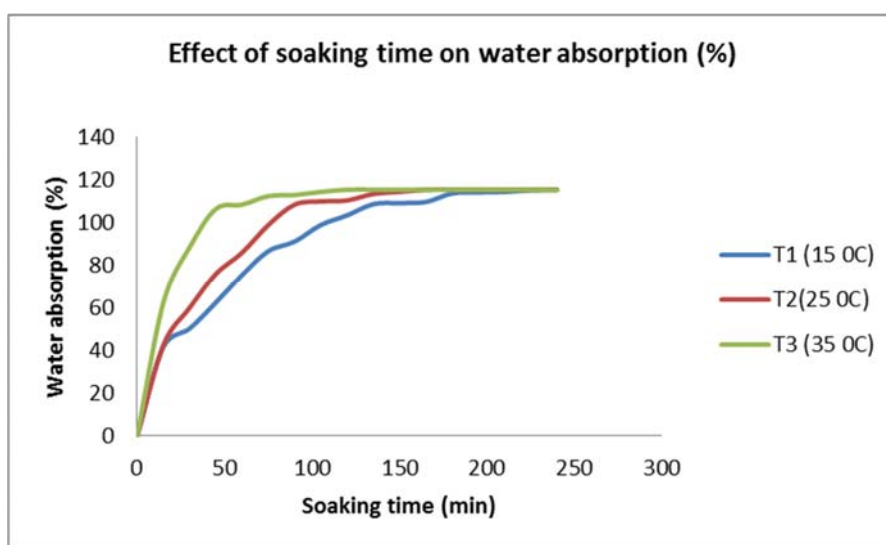


Fig. 3: Effect of soaking time on water absorption (%) of dehulled soybean dhal

Fig.2 shows that the moisture content of dehulled soybean dhal increased from 11.73% to 140.78% at 15 °C, 25 °C and 35 °C water temperatures after 4 hours, 3 hours and 2 hours respectively. The water absorption reached to a maximum of 115.5% of the original weight of the soybean dhal after 4 hours, 3 hours and 2 hours of soaking in water at 15 °C, 25 °C and 35 °C water temperatures, respectively. The water absorption by the dehulled soybean dhal is a diffusion process and is controlled by concentration gradient. The initial water uptake is high due to the high water concentration gradient between the soaking medium and the dry cotyledons of the seeds. As the soaking process continues, the water absorption rate gradually decreased due to decrease in water concentration gradient. Sayar and colleagues (2001) [7] and Abu Ghannam and Mckenna (1997) [1] stated that this is due to filling of water into the intercellular spaces. The rate of water absorption at 15 °C was high in the first and second hours of soaking. The moisture content (% , d.b.) increased from the initial 11.73% to 96.08% and 127.38% after first and second hours of soaking, respectively. In the third and fourth hours of soaking water absorption was gradual and increased the moisture content to a maximum of 140.78%. The rate of water absorption at 25 °C was high in the first and second

hours of soaking. The moisture content (% , d.b.) increased from the initial 11.73% to 107.82% and 135.20% after first and second hours of soaking, respectively. In the third hour of soaking water absorption was gradual and increased the moisture content to a maximum of 140.78%. At 35 °C the rate of water absorption was high in the first hour of soaking. The moisture content (% , d.b.) increased from the initial 11.73% to 132.96% after first hour of soaking. In the second hour of soaking water absorption was gradual and increased the moisture content to a maximum of 140.78%. The similar trend was reported by Munu N, *et.al.* reported the similar trend.

Conclusion

For the preparation of soypaneer, the dehulled soybean dhal can be soaked for 4, 3 and 2 hours at 15 °C, 25 °C and 35 °C water temperatures, respectively to reduce the time of soaking required for hydration of whole soybean.

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