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Dehydration of Ginger Slices

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The results of kinetic study conducted on the dehydration of ginger slices using a tray drier at 55-60°C are reported. It is also revealed that the dehydration of ginger occurs in the falling rate period. The sorption isotherm and rehydration studies conducted on the dried product are also reported. The dried ginger has shown a water activity of 0.58 and the maximum rehydration is obtained after 60 min. The overall acceptability is found to be very good (up to 6 months) for the dehydrated ginger slices packed in 300 gauge HDPE and stored at ambient temperatures.

Introduction

Ginger is one of the principal spice crops in the country and it plays a significant role in earning valuable foreign exchange. India is the largest producer and exporter of ginger to more than fifty countries, particularly to middle east, accounting for more than 70% of the world production[1]. The rotary drier is preferred for ginger dehydration because of lower labour cost[2]. However, unless the ginger is sliced fairly thin, its dehydration is essentially a slow process. It is controlled for the most part by moisture diffusion, which is not hastened by agitation, with the result that the extra power consumption involved in working the rotary drier is not suitable for sliced ginger, since the wet material packed like saw dust forms an impermeable mass through which air cannot penetrate.

Ginger, peeled and unpeeled, has been sliced and pretreated with 2% lime solution; sensory quality of unpeeled ginger dried at 65°C has not been found good. Pretreatment of ginger has not been beneficial but slicing before drying has been recommended. Diffusivity in ginger was obtained by the thorough flow of air. Moisture distribution during the process agreed with theoretical model assuming constant diffusivity. The activation energy was found to be 80.24 kJmol^{-1}. Water migration within the material by the process of diffusion was confirmed by the Arrhenius type temperature dependence of the calculated values of diffusivity[3].

Materials and Methods

Medium sized, healthy and disease-free rhizomes were procured from the local market at Amritsar. These rhizomes were washed, wiped, peeled and cut into 3 cm cubes manually with the help of knife and immersed in 500 ppm KMS solution for half an hour to control the enzymatic activity and retain colour. Fresh as well as dehydrated ginger samples were analysed for moisture, ash, crude fibre and volatile oil content using AOAC methods[4].

The prepared ginger slices were dehydrated in a tray drier (Narang Corporation, New Delhi) at 55-60 and 60-65% relative humidity (RH) based on preliminary trials. The tray load was kept at 7.2 kg/m^2. The moisture loss was determined by weighing the tray at regular intervals. The rehydration ratio was determined by weighing the samples after rehydration in simmering water for different time intervals[5]. Water activity (a_w) was determined using the modified Graphical Interpolation Technique. The varied relative humidity atmosphere conditions were created in desiccators using sulphuric acid solution adjusted to requisite normalities to obtain the desired RH[6]. The dried ginger slices were packed in 100, 200 and 300 gauge high-density polyethylene (HDPE) bags and stored at ambient temperatures (25-30°C) for 6 months. The dehydrated slices were evaluated organoleptically by a panel consisting of ten judges. A 20-point sensory score card was used for this purpose with weightage of 5 for each attributes (colour, flavour and texture). Overall ac-

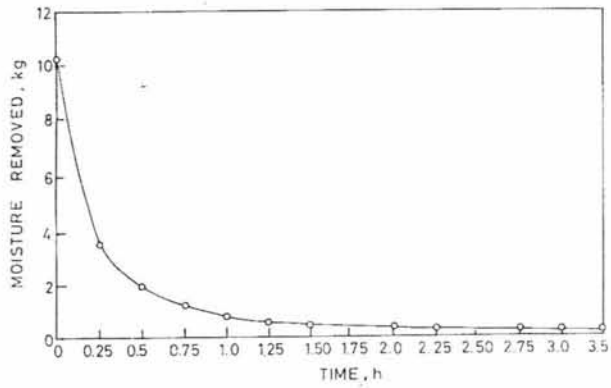

Figure 1 — Drying behaviour of ginger

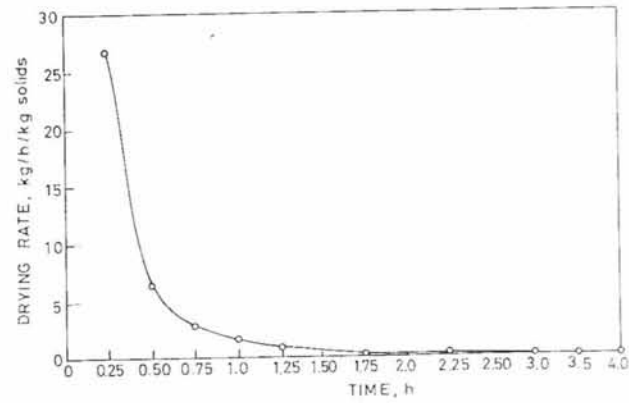

Figure 3 — The change of drying rate with time

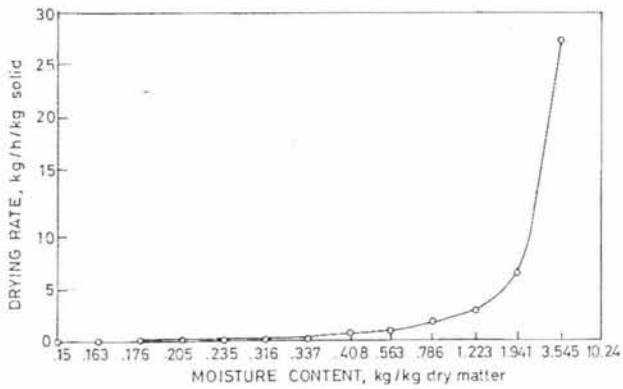

Figure 2 — Drying rate vs moisture content of ginger

Table 1 — Proximate composition of fresh and dehydrated ginger slices (n = 3)

	Dehydrated product	Fresh sample
Moisture, %	7.23	91.0
Ash, %	3.57	2.3
Volatile oil, %	1.60	1.9
Crude fibre, %	4.10	0.9

ceptability score of the product was obtained as the average of the scores for the other three attributes.

The whole experiment was repeated thrice and the average of three values was calculated. The statistical analysis of the sensory data was subjected to repeated measures of analysis of variance (ANOVA) by using GPIS software.

Results and Discussion

The proximate composition of the fresh and dehydrated ginger sample is given in Table 1. The yield was 9% on the basis of raw material. The moisture content of ginger is a function of dehydration time at 55-60°C (Figure 1). A total drying time of 3 hours was required to achieve 7.2% moisture content on wet basis starting with an initial moisture content of 91% in fresh ginger rhizome. The moisture content decreased very rapidly in the first hour and there after the moisture removal rate became almost constant till completion of the process. Figure 2 shows the effect of dehydration rate (kg of water removed/h/kg of material) on moisture content (dry weight basis). It was observed that the dehydration was completed during the falling rate period and was governed by moisture diffusion theory. The moisture removal rate became steeper up to 0.563 kg moisture content and was constant below 0.408 kg water/kg dry matter. Figure 3 depicts that the moisture removal rate was very fast in the first one hour which decreased markedly up to 2.5 hours of drying, becoming constant thereafter.

The ERH curve (Figure 4) shows that the final product has an ERH of 58%. The water activity achieved (0.58) was too low to allow microbial growth. The rehydration curve has been shown in Figure 5. The maximum rehydration ratio of 2.4 was obtained after 60 min of cooking in simmering water.

The sensory data for storage studies of the product at ambient temperatures are shown in Table 2. The product stored in 300 gauge HDPE was highly acceptable and unchanged in organoleptic quality. The change in colour, flavour and texture in 100 gauge HDPE was maximum. The overall acceptability score (Table 2) of

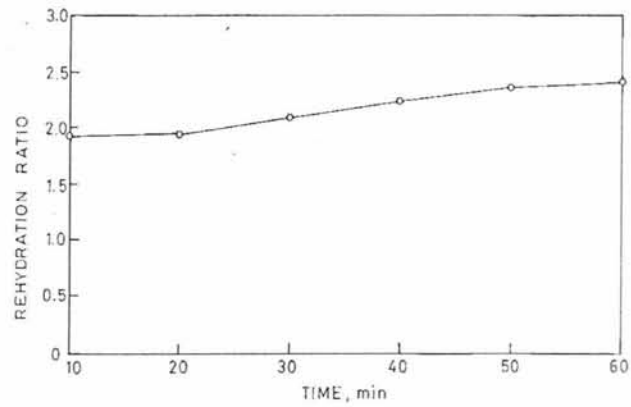

Figure 4 — Rehydration behaviour of ginger

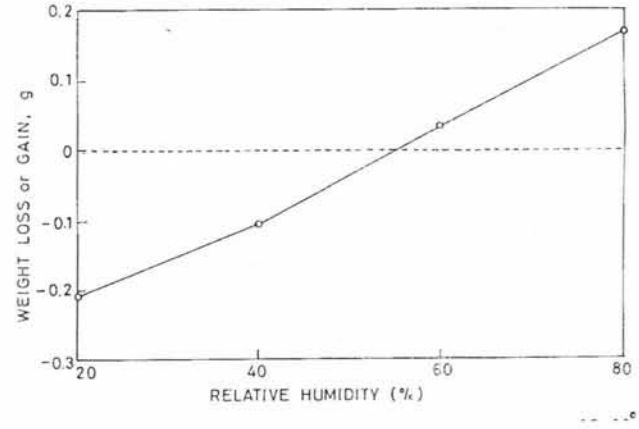

Figure 5 — ERH curve for dry ginger at room temperature (25-28°C)

Table 2 — Organoleptic scores for dehydrated ginger slices stored in HDPE bags (n = 10)

HDPE	Storage period package (gauge)	Colour	Flavour	Texture	Overall acceptability
	2	4.5[a]	4.5[a]	4.5[a]	4.5[a]
100	4	3.5[b]	3.5[b]	3.5[b]	3.5[b]
	6	3.5[b]	3.0[c]	3.0[c]	3.0[c]
	2	4.5[a]	4.5[a]	4.5[a]	4.5[a]
200	4	4.0[b]	4.0[b]	4.5[a]	4.0[b]
	6	4.0[b]	4.0[b]	3.5[b]	4.0[b]
	2	5.0[a]	5.0[a]	5.0[a]	5.0[a]
300	4	5.0[a]	5.0[a]	4.5[b]	5.0[a]
	6	5.0[a]	5.0[a]	4.5[b]	5.0[a]

a,b,c superscripted with different alphabets in columns for each package are significantly different ($p \leq 0.05$)

the product was very good. The statistical analysis of the sensory data indicated that the dried ginger samples remained in excellent condition, all through the storage period of 6 months in 300 gauge polyethylene bags except texture. However, the scores for all the parameters were significantly decreased as the storage progressed in 100 and 200 gauge bags. The main sensory parameters affected during storage were flavour and texture, which in turn, had a bearing on the overall acceptability.

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