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STUDIES ON VARIOUS ASPECTS OF PROCESSING AND STORAGE AFFECTING THE QUALITY OF DEHYDRATED GARLIC

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Dehydration of garlic on large scale has been described. Effect of storage of crop on the quality of the product has been studied. The dehydration ratio and pungency of the product made from the stored commodity was better compared to the product from freshly harvested crop. The effect of particle size on the quality of the dehydrated garlic during storage has also been investigated. It was found that the keeping quality of the product in the form of clove bits was superior to that in the powder form. The sorption isotherms of clove bits and powders of 20 and 30 mesh have been discussed.

Key words: Garlic, Dehydration, Vegetable.

INTRODUCTION

No precise information is available on the commercial aspects of manufacture of garlic powder and its storage, although the technique has been mentioned in the literature [1,2]. These authors' previous work [3] dealt with the design, fabrication and operation of a dehydration plant for the bulk processing of various vegetables. The present paper gives an account of the processing details on the production of dehydrated garlic. Some technical aspects which play an important role in the improvement of the product quality during processing and subsequent storage are described and discussed. Sorption isotherm studies on dehydrated garlic have also been reported.

MATERIALS AND METHODS

Equipment. Garlic was dried in the commercial dehydrator described by Jamil *et al.* [3] in which the first stage of drying was carried out in a twin-tunnel dehydrator followed by the second stage of finishing in a cabinet-type dryer.

Preparation and processing. Garlic bulbs were opened and paper husk blown off by passing through a cloving machine (developed at the PCSIR). The roots, stalks, stones etc. were separated from the cloves on a conveyor belt. The cloves so obtained were thoroughly washed and fed to the rotary chopper. The chopped cloves or clove bits (3–4 pieces off a clove) were spread on trays which, in turn, were loaded on trolleys. These trolleys were subjected to dehydration, first in the tunnel dehydrator and later in the finishing dryer to yield a product of about 5 % moisture content. At the end of the drying cycle, the material was passed through a husking machine to separate the husk from kernel pieces. The dried pieces of kernels or clove bits, obtained from the machine, were put in tin canisters which were hermetically sealed. These were stored at room temperature. Whenever required, a quantity could be taken out, milled and supplied in retail or bulk packs. A few samples were ground to 20 and 30 mesh powder and similarly packed in canisters and shelved alongside clove bits for storage studies. A flow sheet for garlic processing is shown in Figure 1.

Analytical methods. Moisture content in the raw and dried vegetable was determined by the AOAC (1980) method [4]. The level of browning or discolouration in the garlic powder was measured by the method of Pruthi *et al.* [5] and the absorbance of the filtrate at 420 nm is reported as browning index. The pungency of the stored garlic was determined as odour threshold value after Peleg *et al.* [6]. Taste evaluation of dehydrated garlic was made using a tomato soup. The soup was prepared by diluting tomato juice (4° Brix) with equal amount of water followed by adding 1 % salt and 0.5 % corn flour; the mixture was boiled and subsequently cooled to 50°. To this soup was added 0.02 % garlic powder while stirring. The mixture was kept at 50°. A panel of 6 members was asked to taste the soup and to rank it using a scale from 10 (best) to 1 (worst), with 5 being still acceptable [6]. All the above tests were performed on a powder obtained after milling and screening through a 30-mesh sieve.

Sorption isotherms for garlic powder and clove bits were obtained by employing the Wink's weight equilibrium method [7].

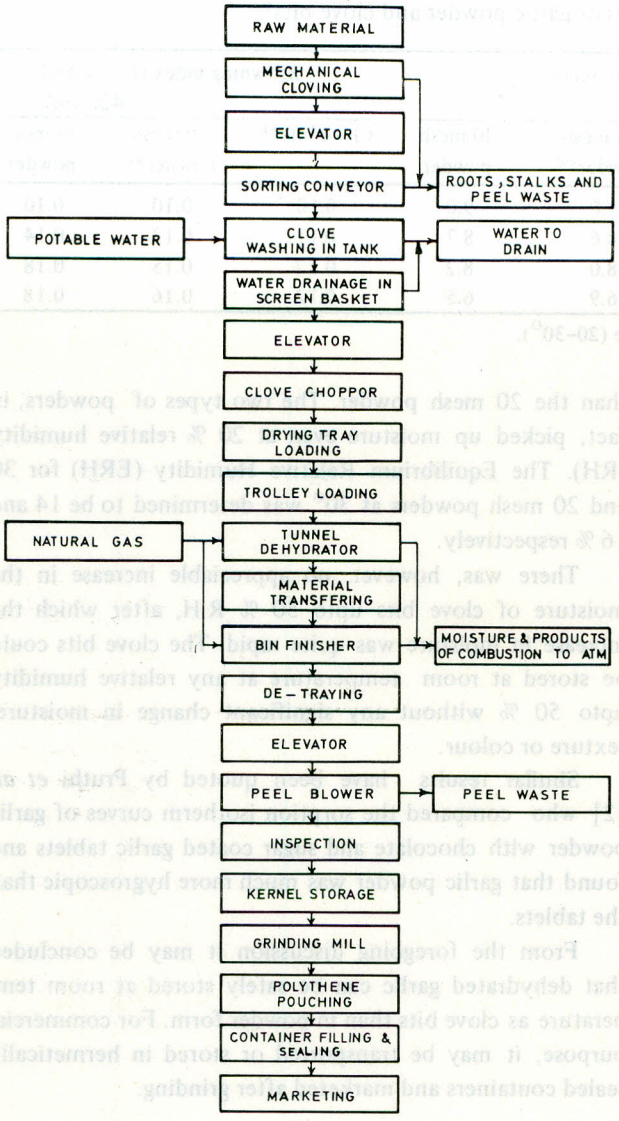

Fig. 1. Detailed flow sheet for garlic processing.

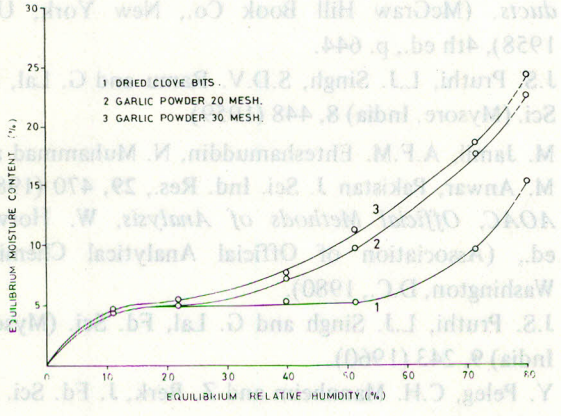

Fig. 2. Sorption isotherms for garlic powder and clove bits at 30°.

RESULTS AND DISCUSSION

Effect of commodity storage on the quality of product. The garlic, harvested locally in early summer, is stored in jute bags in well ventilated rooms for subsequent usage. A variation is likely to occur in the properties and chemical composition of freshly harvested garlic and the stored commodity, which has a direct bearing on the quality of garlic powder produced by dehydration.

Results from Table 1 show that the freshly harvested vegetable had a higher moisture level (67 % average) which decreased gradually during storage, till it reached a low value of 63.2 % in the month of October. This loss of moisture was mainly due to the evaporation of water from the vegetable. The dehydration ratio (DR), was maximum for the freshly harvested crop and the pungency of the product made therefrom was minimum. The DR value during July and August decreased to a low value of 3.8 and then tended to increase again for the subsequent months. The higher DR values for the matured commodity, processed during September and October, were due to the microbial spoilage of garlic bulbs in jute bags, which were, of necessity, sorted out prior to dehydration. It was noted, however, that the pungency of the product made from the stored commodity was maximum during the period from June to September. The odour threshold value was minimum (around 13 ppm) for these months. It may be concluded that the above four months of summer are ideal for garlic processing as the DR value of the vegetable is minimum and the pungency of the product maximum.

Table 1. Variation in moisture and dehydration ratio of garlic and pungency of the dehydrated product during storage*

Month	Moisture content (%)	Dehydration ratio (DR**)	Pungency of powdered product (odour threshold in ppm)
April***	67.0	4.5	20.0
May***	65.2	4.3	18.3
June	64.0	4.0	13.3
July	63.7	3.8	13.3
August	63.5	3.8	13.3
September	63.5	3.9	13.3
October	63.2	4.3	15.0

* Jute bags, containing garlic bulbs, stored in a well ventilated room.

** Dehydration ratio = $\frac{\text{wt. of fresh vegetable}}{\text{wt. of dehydrated vegetable}}$

*** Freshly harvested sample.

Table 2. Effect of storage on some qualities of garlic powder and clove bits*

Storage time (days)	Odour threshold (ppm)			Taste score			Browning index (E 1 cm 420 cm)		
	Clove bits**	20 mesh powder**	30 mesh powder	Clove bits**	20 mesh powder**	30 mesh powder	Clove bits**	20 mesh powder**	30 mesh powder
0	11.6	11.6	11.6	9.0	9.0	9.0	0.10	0.10	0.10
60	13.3	15.0	13.3	9.0	8.6	8.7	0.11	0.13	0.14
120	13.3	21.6	18.3	8.8	8.0	8.2	0.12	0.15	0.18
180	13.3	25.0	30.0	8.8	6.9	6.5	0.12	0.16	0.18

* Packed in hermetically sealed tin canisters and stored at room temperature (20–30°).

** Freshly ground to 30 mesh before carrying out the tests.

Effect of particle size of the product on storage. Three lots of dehydrated garlic each varying in the particle size were stored separately in tin canisters as mentioned earlier. The first lot consisted of unground bits received directly from the husking machine. The second and third lots consisted of garlic powder of mesh 20 and mesh 30 respectively. After two months interval, a sample was drawn out from each lot and evaluated for taste, pungency and browning. The results are shown in Table 2.

It will be seen that during 6 months' storage period, the odour threshold values for the 20 and 30 mesh powder increased consistently over the storage period, whereas the results showed a slight increase in the threshold values for the freshly ground powder of clove bits. The lower levels of odour threshold (11.6 and 13.3 ppm) are indicative of higher pungency levels for the clove bits. Results of taste testing showed highest scores for samples stored as clove bits and did not change much over a period of 6 months. The rating for powder samples of 20 mesh lowered from 9.0 to 6.9 and that for 30 mesh samples decreased to a value of 6.5 at the end of 6 months' period. Both powder samples could be rated as 'good', while the freshly ground clove bits could be held to be 'very good'.

The browning index for the powders of 20 and 30 mesh increased by 60 and 80 % respectively over 6 months' period indicating thereby the coarse powder (20 mesh) was less susceptible to brown discolouration than the fine 30 mesh powder. The freshly prepared powder from garlic bits on the other hand showed only slight variation in the browning index and the colour of the product was an attractive creamy white. Probably the powdered samples picked up moisture during grinding which resulted in higher rates of browning during storage compared with the clove bits.

Sorption isotherms of garlic powder and dried clove bits. Fig. 2 shows sorption isotherms of garlic powder (30 and 20 mesh) and dried clove bits, which are typically 'S' shaped curves for the three samples. It will be noted from the figure that 30 mesh powder is more hygroscopic than the 20 mesh powder. The two types of powders, in fact, picked up moisture even at 20 % relative humidity (RH). The Equilibrium Relative Humidity (ERH) for 30 and 20 mesh powders at 30° was determined to be 14 and 16 % respectively.

There was, however, no appreciable increase in the moisture of clove bits upto 50 % R.H, after which the increase in moisture was quite rapid. The clove bits could be stored at room temperature at any relative humidity upto 50 % without any significant change in moisture, texture or colour.

Similar results have been quoted by Pruthi *et al.* [2] who compared the sorption isotherm curves of garlic powder with chocolate and sugar coated garlic tablets and found that garlic powder was much more hygroscopic than the tablets.

From the foregoing discussion it may be concluded that dehydrated garlic can be safely stored at room temperature as clove bits than in powder form. For commercial purpose, it may be transported or stored in hermetically sealed containers and marketed after grinding.

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