STUDIES ON THE DEHYDRATION OF ONIONS

By

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Introduction

The characteristic operation in food dehydration is drying, that is, the removal of water by vaporization. Since the ultimate goal of this operation is the retention of a good color, flavor, texture, and high nutrative value, the conditions of dehydration must be carefully controlled to avoid as much as possible any defects in these qualities.

The onion has been known and cultivated as a crop used for human consumption from the dawn of history. During world war II the industry of dehydration was established in U.A.R. to supply mainly the army troops with their needs of dehydrated foods mainly onions, potatoes, carrots and other vegetables.

When the second world war was ended in 1945 the demand for dehydrated foods abroad was collapsed to the extent that some of the factories stopped operation.

The onion is almost universally used, in the daily diet as a food ingredient and nearly by all hotels, restaurant and institutional cooks as a vegetable among others in the salad or as a seasoning or ingredient in many kinds of food preparations. Catchup, Chill sauce, comminuted meats, pickles, mayonnaise and salad dressing, soups, stews and many other commercially prepared, commonly used food items contain some quantities of onions.

The dehydration industry began in the U.A.R. in 1[illegible] in a factory at Maghagha. Recently there are two companies belonging to the Egyptian General Organization for Food Industries for dehydrating vegetables and fruits, El-Nasr and Alexandria, Co. with industrial plants located at, Sohag; Port-Said; Alexandria, and Kafr-El-Dawar, beside two factories belonging to the commercial organization and some smaller ones belonging to the private sector.

Table (A) shows the amounts exported as dried onion from 1963/1964 through 1967/1968 seasons.

Table (A): U.A.R. export of dried onions and corresponding value.*

Year	Amount Exported (tons)	Value (L.Eg.)
1963-64	4161.827	1272956
1964-65	5331.882	1291057
1965-66	4580.182	968264
1966-67	4393.903	937364
1967-68	4244.381	1076915

* Central Agency for Public Mobilisation & Statistics.

1- The chemical composition of fresh onion [illegible] locations.

2- The effect of drying conditions on drying rate.

3- The effect of drying conditions during the dehydration process on volatile sulfur content and the formation of pink color in dried onion.

4- The effect of storage on moisture content, volatile sulfur content, and color of dried onion.

Review of Literature

A- Varieties of Onions.

Onion varieties vary materially in yield per acre, drying ratio, sugar content, punguncy and color. Pungent varieties of light color are preferred in dehydration.

Jones and Bisson, (1934) reported that the percentage of dry matter of eight varieties of onions ranged from 5.5 to 12.10. Cruess and MacKinney, (1943) determined the drying ratio for several varieties of onions which ranged from 6.9:1 to 13.7:1.

The Egyptian onion varieties as described by Morsy, (1960) and may be used in dehydration are, Seady; Giza 6; Selected Giza 6, and Behairy.

1- Sulfur Compounds:

A distinctive characteristic of most members of the genus "Allium" is their onion or alliaceous odor. A large number of invistigators have studied the sulfur compounds of onions and garlic. Some have worked with vapors or distillates of ground pulp (Niegisch & Stahl, (1956) and Carson & Wong, 1957) while others have studied the transformations which take place when tissues are injured (Cavallito et al, 1944, Stoll & Seebeck, 1948; Fujiwara et al, 1952). The results of these studies may be briefly

[illegible] follows:

A colorless, odorless, water soluble amino-acid like compound known as alliin is present in uninjured garlic. On injury of the cells, an enzyme, called alliinase, comes in contact with alliin, and causes its breakdown into a sulfur-containing product, named allicin. Allicin is the anti-bacterial substance of garlic, and has the typical odor of fresh garlic, it is unstable and breaks down into the strong-smelling constituents of garlic oil. The structures of both alliin and allicin are well established.

The alliin of Allium Sativum "garlic" contains an allyl radicle from which is derived the pungent diallyl disulfide of garlic oil, and possibly the other observed allyl products. Smaller amounts of the methyl, and possibly the propyl homologues of allicin, are also present. Allium-Cepa "Orion" on the other hand shows no evidence of the existence of allyl propyl disulfide, it contains methyl and propyl derivatives of alliin, but no true alliin. These differences account, at least in part, for the distinctive odor and flavor of these two species, and for the differences among the distilled products as described above where garlic oil yielding largely allyl compounds, and onion oil yielding methyl and propyl compounds.

The average volatile sulfur content of the whole head of onions and clones of garlic measured by Platenius method was nearly the same for both species (Choudhri et al, 1964).

Pyruvic acid was isolated from Ebenzer onions, Emmett, (1945), and from onion extract in cellulose powder column, Vilkki, (1954).

There are also a highly significant correlation existing between the amount of enzymatically developed pyruvic acid present in juice of communited onion and the olfactory threshold concentration of the juice. This correlation may be used to calculate the strength of onion odor, Schwimmer, et al (1962, 1964).

Fujiwara & Watnabe, (1952) and others have shown that allicin (or its homologues) of onions reacts with thiamine to form compounds which they named allithiamines. These compounds do not respond to some of the common tests for thiamine, and are absorbed from the human intestinal tract more readily than thiamine. They may increase the intake of thiamine from foods since they may be readily utilized by the body. These authors suggest, for example, that raw onions should be eaten with cruciferous crops to make the vitamine B_1 of the latter more readily available.

[illegible] of the [illegible] color, [illegible].

Cavicchi, (1950) determined allyl sulfide in garlic and onion by leaving 5-10 gram from the sample in H_2O for 24 hrs. and carried out steam distillation. The distillate was then treated with 1-2 g. KBr and 5-6 cc. concentrated HCl and titrate with 0.1 N $KBrO_3$ solution in the presence of methyl orange as indicator, the end point determined the decolorization of the latter.

Neigisch and Stahl, (1956) reported all of the volatile odors iminating from onions. They found that no evidence of the existence of allyl propyl disulfide. They used gas partition chromatography which was better in separation and would facilitate the detection of materials present in extremely small concentrations. Hartman and Folle, (1957) designed an apparatus for the rapid electrochemical estimation of flavors in vegetables. The apparatus is a single type of sensitive element polarized a specific voltage.

Farber, (1957) proposed a method to determine volatile sulfur reducing substances (V.R.S.) by aerating the sample, produced V.R.S. were received in alkaline potassium permanganate. The excess solution of which was titrated with sodium thiosulfate. The aeration time, the concentration

[illegible] ing reagent [illegible] various onion and garlic preparations. Specific steps have to be established, however, to suit particular experimental conditions. Farber, and Lerke, (1967) substitute these method by a colorimetric one. The net absorbance of 610 mμ is determined from the difference in absorbance between the unreacted and reacted 0.02 N $KMNO_4$ in N NaOH solution.

Punguncy of different onion varieties:

Platenius and Knott, (1941) reported that the different varieties of onions differed considerably in their volatile sulfur content. This was confirmed by Hussein, (1954) who showed that the volatile sulfur content varied with the varieties of onions as given in table (B). Although onions were grown in widely separated locations, differences in punguncy as a result of ecological conditions were relatively small, though fairly constant.

Jones and Bisson, (1934) studied the relationship between punguncy and moisture. He found that the varieties of high moisture content showed a decrease in punguncy. The enviromental conditions such as temperature, water supply, types of soil and stages of maturity and storage after ripening also had definite effects on the volatile sulfur content of onion.

Variety	V.S.C. p.p.m.	Dry Matter
English varieties:		
South port Yellow Globe	82.10	11.7
Red Zittan	87.50	12.7
White Spanish	102.70	13.4
French varieties:		
Saint Michel	72.10	11.1
Jaine Paille de vertus	92.70	10.8
Egyptian variety:		
Giza 6	126.10	17.6

Hussein, et al, (1965) found that, addition of fertilizers (calcium nitrate, and calcium nitrate and potassium sulfate) increased the volatile sulfur content. High levels of nutrients decreased the volatile sulfur content.

2) Sugar Content:

Bennett, (1941) measured reducing sugars (as glucose) and non-reducing sugars (as sucrose) of Ebenzer onions and found it to contain 64.23 per cent soluble sugars, 11.34 percent reducing sugars and 52.89 percent non-reducing sugars.

[illegible] (1955) determined [illegible], and polyfructosan by using paper chromatography. Wilson and Peterson, (1958) identified sucrose, glucose, and fructose, but did not specify the amounts present. Nelson, (1957) found the same sugars and, in addition, a series of water soluble mainly non-reducing oligosaccharides whose chain length did not exceed eight residues. No fructose polysaccharides were present. The oligosaccharides were absent from the outer scales, but constituted more than half of the soluble carbohydrates of the inner scales.

Abd-El-Bar, (1968) found sugars; fructose; Glucose, sucrose; melibiose; raffinose, and stachyose in Giza 6 variety grown in Sohag Province.

Hussein, et al, (1965) found that, no change occured in reducing sugars, where non-reducing and total sugars decreased by the addition of the fertilizer calcium nitrate alone. The large amounts of fertilizers (calcium nitrate with each calcium phosphate and potassium sulfate) decreased the two components.

3- Other Contents of Onions:

Winton, (1947) reported that onion have protein 2.28, fat 0.22, fiber 0.76, and 0.68 ash percent (on fresh basis). Sherman, (1952) found some mineral elements, those