Pak. j. sci. ind. res., vol. 32, no. 12, December 1989

PRELIMINARY STUDIES ON THE DEHYDRATION OF CITRUS FRUIT JUICES

F.M. KHAN AND EIJAZUDDIN
PCSIR Laboratories, Peshawar, Pakistan

(Received June 1, 1987; revised December 24, 1989)

Juice from different varieties of citrus fruits grown in NWFP, were processed, concentrated and preserved. The concentrated juice was dehydrated after the addition and thorough mixing of appropriate flavour preservating agents. The dehydrated product of all the three citrus varieties i.e. Malta (sweet orange), Kinno and Fruiter were prepared. The juice powder, properly packed (in air-tight containers) and stored, had a shelf-life of upto 3 months. However, the product kept in glass bottles packed in polyethylene bags, had a tendency to absorb moisture and develop lumps with the passage of time. The products obtained were analysed for nutrients and other attributes and the data given.

Key words: Dehydration, Citrus juices, Juice powder

Introduction

Citrus juice powder were first produced during world war II in the U.S. for defence forces. However limited work has been done on the natural juice powder of the fruits commonly grown in the subcontinent. It was, therefore considered appropriate to undertake investigations on the dehydration of local citrus juices and explore the possibilities of reducing packing cost for the fruit preservation industry.

Although it is known that exposure of citrus juices to high temperature results in almost complete loss of volatiles [1], it is possible to minimize flavour losses with the help of proper preservating agents [2] and the dehydration of citrus juices by hot air drying techniques in Cabinet dryer [3].

Materials and Methods

Good quality fruits of citrus varieties i.e. Malta, Ruby red valencia Washington navad, Kinno and fruiter were washed with tap water. Juice from sweet oranges was entreated by Reamer machine. Peeled kinno and fruiters were pressed through muslin cloth. Homogenized juice alongwith suitable flavouring agent was concentrated to about 1/3rd of its original volume through flash evaporator. Thickner was added after concentration. Stainless steel trays containing concentrated juice were placed in a Mitched cabinet dryer initially heated at a temperature of 95°. Gradually the temperature was decreased to 60-75° for dehydration (3-5% moisture). The dry product were scratched from the trays and placed in bin containing an appropriate dessicant such as Silica Gel/Gipdry to reduce the moisture content to 1-3%. The product was mixed with sucrose (as filler) free flowing agent like syloid silica, Mg Co_3, calcium monostearate (with permissible limit), citric acid and FD + C approved colouring material such as Maltrin M (Table I) and packed in air tight container after grinding.

Recipe. Workable recipes for the instant Malta, Kinno and Fruiter juice powders used in the present work are given in Table 2.

TABLE 1. ADDITIVES AND THEIR QUANTITIES USED IN THE PREPARATION OF DRY CITRUS JUICE BASE.

Fruit	Orange (Malta)	Kinno	Fruiter
Additives	Concentration (g/100 g juice)		
Potassium Mata-bi-sulphite	0.2% a	0.2% a	0.2% a
Cane sugar	20% a	20% a	20% a
Modified starches	0.25% a	0.3% a	0.20% a
Colouring matter, (Maltrin-M)	0.05% a	0.07% a	0.05% a
Syloid silica	1% a	1% a	1% a
Magnesium carbonate	0.2% b	0.2% b	0.2% b

a = Before dehydration/concentration. b = After dehydration.

TABLE 2. COMPOSITION OF RECIPES OF INSTANT JUICE POWDERS

S.No.	Constituent	Weight (g)
1	Dry (fruit juice) base	100.00
2	Sugar	50.00
3	Citric acid	0.05
4	Food colour	0.02

Prepared juice was tasted by a test penal of PCSIR Laboratories. Commercially prepared juice (Squash) of reputed firm, was served as control. In order to evaluate the product for appearance, flavour, mouthfeel and taste, a score card numbered 0-10 on hodonic scale (0 = not acceptable 10 = excellent) was given to penal members (Table 3).

Chemical analysis. Moisture content of the powders was calculated on the basis of weight loss during drying in a vacuum oven for 30 hrs. at 60° and 0.6 mm Hg. pressure[4]. Sugar (reducing, non- reducing and total) and acidity were determined by the Rucks[5] method, fat (pet. ether extract) and ash content were estimated by the AOAC method[6] (Table 4).

TABLE 3. ORGANOLEPTIC EVALUATION OF INSTANT CITRUS JUICES AS COMPARED WITH THE COMMERCIALLY AVAILABLE CITRUS PRODUCTS (MEAN SCORE OF 10 JUDGES).

S. No.	Product tested	Appearance 10	Flavour 10	Mouthfeel 10	Taste 10	Total score 40
1	Orange juice powder	7	6	6	7	26
2	Commercial-I (orange squash)	7	8	7	8.5	30.
3	Commercial-II (orange squash)	8	7	8	7	30.0
4	Commercial-III (orange squash)	8	6	7	6	27.0
5	Commercial IV	7	6.5	7	6.5	27.0
6	Instant Kinno juice powder	7	5	6	5	23
7	Instant fruiter juice powder	5	3	6	3	17

The sample for testing the powdered product was prepared by mixing one part of juice powder with 3-4 parts of water. In case of Squash I part of concentrate was mixed with 4 parts of water. The identity of each sample was, however, kept secret.

TABLE 4. CHEMICAL COMPOSITION OF MALTA, KINNO AND FRUITER JUICE POWDERS (AVERAGE OF THREE REPLICANTS).

S. No.	Constituent	Moisture (%)	Ash (%)	Total sugar (%)	Reducing sugar(%)	Total acidity (%)	Ascorbic acid g/100 (g)
Product							
1	a. Malta juice powder	3.15	0.68	91.78	4.44	1.5	27.98
	b. Fresh juice	89.00	-	7.60	3.90	0.59	67.60
2	a. Kinno powder	2.16	0.76	92.78	4.1	1.5	26.02
	b. Fresh juice	89.00	-	7.40	3.27	0.58	24.80
3	a. Fruiter juice powder	2.75	0.70	91.10	4.4	1.3	23.24
	b. Fresh juice	88.00	-	8.50	3.57	-	50.50

Results and Discussion

According to Table 3 Malta juice powder was reasonably good (some even preferred it to canned juice). Kinno was indicated to be satisfactory while fruiter was considered to be lacking in quality characteristics.

The results from this study indicate that the citrus fruit juices and their concentrates can be satisfactorily transformed into dehydrated products by adding suitable dehydraton aids/ flavour preservation agents. In the preparation of citrus juice powders, sucrose, Tri-calcium phosphate and artificial silicas (Grace & Co., USA) were also incorporated at a concentration of (10-25) 0.15 and 0.10% respectively before the dehydration process. As reported by Eakew [7] for grape juice, sucrose played several important roles, besides helping in reducing the hygroscopicity of the dehydrated juice powder, it was also useful in retaining the volatile constituents (flavour and aroma) of the fruit juice. Recent reports in the literature[8] indicate that modified starches also play a vital role in the preservation of flavour during dehydration.

It can be judge from Table 4 that the dehydrated juice products are highly rich in total sugars, mainly because of sucrose. Ash content of all the juice powder is apparently high, which can be attributed to the addition of inorganic salts. Total acidity of the powdered product seems to be high, but when the powder is reconstituted, the level is fairly comparable with the fresh juice.

Lower ascorbic acid content in the products is due to prolong exposure to heat and air. However, it could be incorporated exogenously without adding much to the production cost. Besides costing low, a desirable dehydrated product should also have reasonably good flavour and free-flowing characteristics. The dehydrated juices have generally been found to be highly hygroscopic and the citrus juices are no exception. Whereas the flavour preservation is looked after through the incorporation of sucrose and appropriate starches; addition of synthetic silica, $MgCo_3$ and other poly-saccharides contribute significantly in preventing the solid-mass formation at the beginning. Periodic organoleptic evaluation of the product during storage, however, demonstrated slight to considerable changes in free-flowing characteristics and flavour, depending upon the period and conditions of storage Berry *et al.* [9] reported similar changes during storage of citrus juice powders prepared by the advanced techniques of freeze-drying. Canned products are also known [10] to undergo changes in both sensory quality and nutritional values during the storage. This could possibly be prevented, or at

least reduced, by the judicious use of suitable laminated packaging material, appropriate packing techniques with controlled humidity. Packing under an inertatmosphere and controlled temperature may further help in enhancing the shelf- life of the product.

Acknowledgement. We would avail this opportunity to thank M/s. H.M. HUBER Corporation, Chemical Division and M/s Grain Processing Corporation Muscatine IOWA USA for the generous supply of Samples of synthetic Silicas and Maltrin respectively.

References

1. P.J. Anderson and N. Ahmed, Fd. Manufacture, **49**, 35(1974).
2. *Hand Book of Food Additives*, T.E. Furia (Edi.) (CRC Press Inc. Florida) 2nd Edition, pp. 392.
3. H.W. Von Loesocke, *Drying and Dehydration of Foods* (Reinhold Publishing Corp., N.Y, 1955) 2nd Edition.
4. E.A. MC. Comb and H.M. Wright, Fd. Tech; **8**, 73 (1954).
5. J.A. Ruck, *Chemical Method for Analysis of Fruit and Vegetable Products*, Deptt. of Agriculture, Canada (1963).
6. AOAC; *Official Methods of Analysis* (Association of Official Analytical Chemists, Washington, D.C., 1955) 9th Edition.
7. R.K. Eskew, H.I. Cinnanmon and V.A. Furkot, Fd. Tech; **8**, 27 (1954).
8. D.B. Wurzberg, *Starches in the Food Industry in "CRC Hand Book of Food Additives* (published CRC Press Inc., Florida, 1981) Vol. 1, 2nd Edition.
9. Berry *et al.*, A review of the applied Res. on citrus Juice Crystals. Proc. Conference of Citrus Chem: Utility p. 11, USDA. (1967).
10. S.R. Cecil and J.G. Woodroof, Fd. Tech. **17**, 639 (1963).