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SCIENTIFIC SUB-COMMITTEE

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(+ Annexes I and II)
O. Eng.

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CLASSIFICATION OF TROPICAL FRUIT PRESERVED BY THE ADDITION OF SUGAR AND DRYING

(Item II.12 on Agenda)

Reference documents :

39.720 (HSC/16)
39.600, Annex IJ/26 (HSC/16 - Report)
40.084 (HSC/17)
40.293 (HSC/17)
40.295 (HSC/17)
40.260, Annex IJ/1 (HSC/17 - Report)
40.451 (HSC/18)
40.645 (HSC/18)
40.699 (HSC/18)
40.795 (HSC/18)
40.600, Annex H/2 (HSC/18 - Report)
41.173 (HSC/19)
41.100, Annex G/1 (HSC/19 - Report)
42.403 (HSC/22)
42.750, Annex G/34 (HSC/22 – Report)

I. BACKGROUND

1. On the basis of a request submitted by the EC, the Harmonized System Committee has been examining the classification of tropical fruit (e.g., pineapple, papaya) preserved by osmotic dehydration in a sugar solution, followed by air dehydration. These products were imported into EC from Thailand, Philippines and Taiwan.

File No. 2560

Description of the manufacturing process

2. According to the information provided by Thailand (Doc. 40.084), the fruit is first peeled, cut and sliced. The pieces are then blanched by placing them in boiling water or in a steam blancher for a short period of time (not more than 45 minutes, the duration pending on the thickness and texture of the pieces) to inhibit enzyme action.

3. After blanching, an osmotic dehydration process is used for removing water contained in the fruit by surrounding the fruit pieces with a concentrated sugar solution at about 50 °C. During this process, the cell walls of the fruit act as a semi-permeable membrane and the water diffuses from the fruit, through the membrane (cell walls), to the concentrated solution until an equilibrium concentration is obtained (see paragraph 4 below). After the weight of the fruit has been reduced by about 50%, the osmotic dehydration is discontinued and the fruit is removed from the sugar solution and drained. It is then subjected to a further air dehydration process, by placing in wire meshed trays in a dehydration tunnel (24-72 hours). The water content of the final product is less than 18% and it has a shelf life of up to 12 months.

4. The osmotic dehydration process, as described by the Thai Administration (Doc. 41.173, paragraphs 5 and 6), is excerpted as follows :

> "In the osmotic dehydration process, the sliced pieces of fruit are placed in sugar syrup with a density from 30-70º Brix at approximately 50 ºC for 24-72 hours (1-3 days). During the process, only water and soluble solid diffuse from the fruit, through the cell walls, to the sugar syrup. Sugar (sucrose) from the syrup, which is a big molecule (with a larger ionic radius), has not yet diffused, through the cell walls, to the fruit. The partially dehydrated fruit is then removed from the sugar syrup, drained, and subjected to further air dehydration process. In the process of preserving fruit by sugar, osmotic dehydration does occur at the beginning of the process, but after continuing placing the fruit in a sugar syrup with the density of 70º Brix for 3 weeks (slow process) or 3 days (quick process, with continuous boiling), sugar (sucrose) from the syrup is forced to diffuse into the fruit to replace most of the water in the fruit. The function of sugar in the process is for preservation. It is then obvious that the osmotic dehydrated and air dried fruit is not fruit preserved by sugar."

Developments in the HSC

5. The main question before the Committee was whether the product in question could be considered dried fruit of Chapter 8 or fruit prepared or preserved classifiable in Chapter 20. When the Committee first examined the matter at its 17th Session, it decided to have samples of the products in question analysed by three independent Customs laboratories to determine, *inter alia*, the extent of the destruction of the cell walls of the fruits, sugar/ash ratio, sugar/acid ratio, sugar/protein ratio, loss of minerals or acids and the extent of added sugar.

6. Consequently, Customs laboratories in Korea, Japan and the United States examined four samples. Korea found that the samples had a higher sugar content than that of the reference materials, while Japan and the USA did not give conclusive data in this regard (see Docs. 40.795 and 40.699, paragraph 2.2). Japan reported that the cell walls were not destroyed in all samples (see Doc. 40.451, paragraph 6). A summary of the findings by the three laboratories is set out in Annex I to this document.

7. At its 19th Session, when the Committee re-examined the classification question, taking into account the analytical results, it was not in a position to take a final decision on the classification. Instead, the Committee discussed the possibility of carrying out further studies with regard to the extent of added sugar to be allowed in the dried fruit of Chapter 8, on the basis of information and comments to be submitted by administrations. However, the study could not proceed in the absence of sufficient data.

8. At its 22nd Session (November 1998), the Committee once again examined this classification question at the request of the EC. The EC also submitted some additional information based on isotopic analysis carried out by the French Customs Laboratory (see Annex II).

9. During the discussion, the Canadian Delegate informed the Committee that the results of isotopic analysis carried out by the Canadian Customs Laboratory were similar to those obtained by the French Customs Laboratory.

10. The Delegate of Switzerland suggested that laboratory analysis to determine the content of elements such as potassium, phosphorus and magnesium would be helpful to distinguish between dried fruit of Chapter 8 and preserved fruit of Chapter 20. He said that the potassium content of dried fruit of Chapter 8 was in the range of one-third to one-half that of fresh fruit, whereas the potassium content of fruit preserved by sugar (Chapter 20) was only 0.5 to 5 percent of that of fresh fruit.

11. After discussion the Committee decided to seek the advice of the Scientific Sub-Committee on the following questions :

(a) the desirability of prescribing an added sugar content criterion to distinguish between fruit products of Chapter 8 (whether or not with a small quantity of added sugar) and Chapter 20;

(b) whether the osmotic dehydration process described by Thailand (see paragraph 4 above) was basically a drying process for fruits (whether or not with small quantities of added sugar) or was intended to produce fruit preserved by sugar (drained, glacé or crystallised);

(c) the analytical method for determining the quantities of added sugar (excluding replacement) in dried fruit;

(d) whether the isotopic method applied by France was a reliable method for the determination of the exact quantity of <u>added</u> sugar and whether it could be uniformly applied for all fruits;

(e) whether determination of the amount of minerals, in particular, potassium, could be used as a criterion for distinguishing between (i) dried fruit with small quantities of added sugar and (ii) fruit preserved by sugar.

12. The Committee also asked the Thai Administration to supply samples of fresh fruit (papaya and pineapple) and the corresponding dried fruit prepared by osmotic dehydration and air drying, to be tested by the Customs laboratories of Canada, Japan and France for determining the extent of <u>added</u> sugar for the information of the Scientific Sub-Committee.

These test results are still awaited and would be submitted to the Sub-Committee as soon as they become available.

II. SECRETARIAT COMMENTS

Desirability of added sugar content criterion

13. At the Harmonized System Committee's 22nd Session, the Thai Delegate took the view that a distinction between dried fruit of Chapter 8 and preserved fruit of Chapter 20 based on an "added sugar" criterion would not be feasible, since the sugar content would depend upon the variety of the fruit, the place it was grown, season, maturity, etc. However, the analysis performed by the French Customs laboratory seems to have indicated that the extent of replacement of natural sugar in a fruit by sugar from an outside source (e.g., sugar cane) could be determined.

14. This being said, the Secretariat pointed out (Doc. 42.403, paragraph 17) that the results reported by the French laboratory indicated some certainty for papaya samples only, and that the test results for pineapple samples were not conclusive. It should also be noted that the results reported for papaya samples indicated "replaced sugar" and not added sugar (see Annex II). The Secretariat also expressed concern that the isotopic method suggested to determine added sugar content was quite sophisticated.

15. The Sub-Committee is requested to take account of the above information and express its views as to whether a "added sugar (excluding replaced sugar) criterion" would be desirable or practical for distinguishing between "dried fruits with added sugar" of Chapter 8 and "fruits preserved with sugar" in Chapter 20.

Whether osmotic dehydration is basically a drying process or is intended to produce fruit preserved by sugar?

16. The Sub-Committee's attention is invited to the osmotic dehydration process described in paragraph 4 above and to express its views as to whether it is a drying process for fruits or a method of preservation by sugar (see HS heading 20.06).

Analytical method for determining sugar content in dried fruit

17. The Sub-Committee is asked to identify an analytical method for accurately and consistently determining the added sugar content (excluding replaced sugar) in dried fruit. In this connection the Sub-Committee's attention is invited to the analytical results summarised in Annex I. It is also requested to take into account the new analytical results expected from the Customs laboratories of Canada, Japan and France (see paragraph 12 above). In this regard, the Sub-Committee may also express its views as to whether or not the determination of added sugar would depend upon ascertaining the sugar content of the corresponding fresh fruit, before it undergoes osmotic dehydration.

Reliability of isotopic analysis for determining increase in sugar content

18. The Sub-Committee is asked to determine whether the isotopic method employed by the French Customs laboratory is appropriate for determining quantitatively the increase in sugar content (excluding replaced sugar) that results from osmotic dehydration process. It is also asked to express its views as to whether the isotopic method of analysis is reliable for all fruits. In this regard, the Sub-Committee is also invited to indicate the nature of equipment and expertise required to carry out isotopic analysis and whether such facilities exist in all Customs laboratories.

Determination of potassium or other elements

19. The Sub-Committee is asked to determine whether a measurement of the loss of elements such as potassium, phosphorus or magnesium could be used as an alternative criterion for distinguishing between “dried fruit” containing small quantities of sugar as allowed in Chapter 8 and “fruit preserved by sugar” (Chapter 20). If so, the Sub-Committee is requested to identify an appropriate laboratory method for making such a measurement.

20. The Secretariat wonders however, whether it is legally appropriate to use a potassium, phosphorus or magnesium criterion in order to distinguish between “dried fruit” with small quantities of added sugar in Chapter 8 and “fruit preserved by sugar” of Chapter 20 because, legally speaking, the basic differences between the two categories depend on the added sugar content and the moisture content and do not depend on potassium, phosphorus or magnesium.

21. Finally the Secretariat wishes to add that the basic idea being considered under this Agenda Item is to find out an appropriate “added sugar” criterion for distinguishing between dried fruit with small quantities of added sugar (Chapter 8) and fruit preserved by sugar (Chapter 20). The Secretariat has strong doubts about the practicability of such a criterion because in order for it to be applied correctly the criterion requires the analysis of fruit actually used for making the product in question and the product in question itself. Such analysis appears too cumbersome. Moreover, it is doubtful whether such fruit actually used for making the product can always be obtained.

IV. CONCLUSION

22. Taking into account the information and comments above, the Sub-Committee is requested to gives its views concerning the questions put forth by the Harmonized System Committee, as set out in paragraph 11 above.

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SUMMARY OF LABORATORY ANALYSIS

(see Docs. 40.451, 40.645, 40.699 and 40.795)

1. The four samples examined were (1) pineapple provided by the Thai Administration, (2) papaya provided by the Thai Administration, (3) pineapple provided by the EC, and (4) papaya provided by the EC.

2. **Total sugar content (i.e., sucrose, glucose and fructose) in % :**

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	92.3	83.3	88.0
II. (Thai papaya) :	78.0	78.4	80.3
III. (EC pineapple) :	[102.1] *	85.2	85.1
IV. (EC papaya) :	86.8	74.7	83.1

* By adding the sucrose, glucose and fructose contents which were separately determined by Japan! Since there appears to be some error in reporting sugar content, the sugar ratio figures concerning this item have also been placed in square brackets in the following tables.

3. **Ash content (in %) :**

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	0.25	0.30	0.18
II. (Thai papaya) :	0.64	0.70	0.49
III. (EC pineapple) :	0.14	0.40	0.11
IV. (EC papaya) :	0.37	0.70	0.31

4. **Sugar (sucrose, glucose and fructose) / ash ratio** :

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	369	278	489
II. (Thai papaya) :	122	112	164
III. (EC pineapple) :	[729]	213	774
IV. (EC papaya) :	235	107	268

5. **Acid content (in %) :**

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	0.21	0.20	0.13
II. (Thai papaya) :	0.18	0.20	0.11
III. (EC pineapple) :	0.10	0.20	0.07
IV. (EC papaya) :	0.19	0.20	0.22

6. **Sugar / acid ratio :**

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	439	417	693
II. (Thai papaya) :	433	392	717
III. (EC pineapple) :	[1021]	426	1216
IV. (EC papaya) :	456	374	373

7. **Protein content (in %) :**

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	0.86	0.80	0.28
II. (Thai papaya) :	0.59	1.90	0.25
III. (EC pineapple) :	0.33	0.50	0.33
IV. (EC papaya) :	0.27	1.50	0.20

8. **Sugar / protein ratio :**

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	107	104	310
II. (Thai papaya) :	132	41	323
III. (EC pineapple) :	[309]	170	257
IV. (EC papaya) :	321	50	408

9. **"Added" sugar, compared with reference material :**

Sample No.	Japan	USA	Korea
I. (Thai pineapple) :	~~± 29 %*~~	N/A	± 19 %
II. (Thai papaya) :	~~± 21 %*~~	N/A	± 13 %
III. (EC pineapple) :	~~± 41 %*~~	N/A	± 16 %
IV. (EC papaya) :	~~± 33 %*~~	N/A	± 16 %

(*) The data first reported by Japan were subsequently withdrawn because they felt that the method of deriving them was not adequate (see Doc. 40.699, para. 2.2).

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ANALYSIS CARRIED OUT BY THE FRENCH CUSTOMS LABORATORY

(Doc. 42.403)

10. "The Paris Customs Laboratory has for a long time been interested in the tariff classification of tropical fruits dried by an osmotic process. Since our laboratory was recently equipped with technology for isotopic analysis, we felt it would be interesting to see how this could improve our understanding of the sugars present in these products. The study was carried out on samples of commercial dried papaya (papaw) and pineapple which had apparently *(emphasis added by the Secretariat)* been processed in the same way.

Principle of the study

11. We know that plants can be broken down into three families according to their biological cycle of assimilation of CO_2 from the atmosphere :

- "C3" plants (beet root, grapes, apricots, papaya, apples, pears, etc.). The various organic compounds produced by these fruits have a $^{13}C/^{12}C$ ratio of about -24 to -30 ‰.

- "C4" plants (sugar cane, maize, etc.) for which the $^{13}C/^{12}C$ ratio is about -9 to -13 ‰.

- Another category called "CAM" (includes pineapples) shows ratios of around -11 to -15 ‰.

Analysis carried out

12. We extracted pulp and sugar separately from papaya (papaw) and pineapple samples. We then carried out quantitative combustion in carbon dioxide. The ratio of stable carbon $^{13}C/^{12}C$ isotopes is then determined by mass spectrometry of the isotope ratio.

13. The $^{13}C/^{12}C$ ratio of the alcohol obtained after fermentation of the sugars was also established.

Results

14.

	Pineapples	Papaya (papaws)
$^{13}C/^{12}C$ ratio of the pulp	-12 to -13 ‰	-24.5 ‰
$^{13}C/^{12}C$ ratio of the sugar	-12 to -11 ‰	-11.8 ‰
$^{13}C/^{12}C$ ratio of the alcohol	-12 ‰	-12.5 ‰

15. These results clearly show that the sugar content in the papaya (papaw) samples does not come from the fruit. The fruit sugar has, therefore, been completely replaced by the sugar content of the syrup in which the fruit is soaked, probably cane sugar.

16. Unfortunately, the biological cycle of pineapples means that it has been impossible to reach conclusions on the pineapple samples."