codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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TO: Codex Contact Points
Interested International Organizations

FROM: Secretary, Codex Alimentarius Commission
FAO, Viale delle Terme di Caracalla, 00100 Italy

SUBJECT: **REQUEST FOR COMMENTS ON THE DEVELOPMENT OF BRIX LEVELS FOR FRUIT AND VEGETABLE JUICES AND NECTARS**

DEADLINE: **31 March 2003**

COMMENTS: **To:**

Secretary, Codex Alimentarius Commission
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BACKGROUND

1. In discussing the Proposed Draft Codex General Standard for Fruit Juices and Nectars, the 2nd session of the Ad Hoc Codex Intergovernmental Task Force on Fruit and Vegetable Juices (Rio de Janeiro, Brazil, 23-26 April 2002) decided to return the aforesaid document to Step 3 for circulation and further comments. On that occasion, the Task Force agreed with the following approach with regard to the development of Brix data in respect of fruit and vegetable juices for which consensus was not reached[1]:

- Brix values provided may be those obtained by governments, industry trade associations, individual firms and academic/research organizations. As a response to a CL, Brix values will be submitted through governments or through recognized international intergovernmental organizations or international non-governmental organizations.
- Brix values provided should differentiate between domestically produced and imported products.
- Brix values provided for domestically produced product should be accompanied by information on the amount of product grown/harvested.
- When available, Brix values should be differentiated by season.
- Preferably, Brix values should be submitted with accompanying information that specifies the temperature at which the determination is made and whether or not the Brix value is acid corrected.
- Raw data should be provided along with summaries of the data. When summaries only are provided, the summaries should provide information on the number of observations on which the summary is based and the amount of product grown/harvested.
- The drafting group should base its recommendation for a Brix value on the mean Brix of directly expressed fruit juice over one or more growing seasons. In determining this value they should consider the volume of product covered by the data presented and base their determination on a fair but proportional evaluation of all data presented to the Task Force.

[1] ALINORM 03/39 para. 28.

2. The Task Force decided to assign the responsibility for the revision and updating of the Brix values for both fruit and vegetable juices and minimum fruit juice and/or purée content for nectars to the Drafting Group on the Revision of the Standard with the understanding that a consolidated list would be presented for consideration by the Task Force at its next meeting.[2] It was agreed that the Drafting Group would clarify the concept of "*fair but proportional evaluation*" to be used for its determinations, based on proposals submitted by Member States and recognized international organizations.[3] The Drafting Group was convened under the chairmanship of Brazil, with the assistance of Australia, Cuba, France, Germany, Mexico, Spain, Thailand, the Netherlands, the United States of America, IFU and other member countries and interested international organizations in Observer status with Codex.[4]

3. The Drafting Group reconvened by the Task Force held its meeting on October 14-18, 2002 in Brasilia, Brazil. It considered the issue of evaluating Brix values for both directly expressed and reconstituted juices. In this regard, concern was expressed by some delegations that the wide range of Brix values that existed with certain fruit juices, particularly orange juice, made it difficult to arrive at a process to evaluate Brix values that was equitable for all countries. Other delegations noted that the procedure agreed upon by the Task Force at its 2nd Session, provided for a fair and proportional handling of the data. The Drafting Group agreed that the approach recommended by the Task Force could form a basis for evaluation of Brix values but consideration of the wide range of Brix values of commercial fruit varieties, particularly for orange juice, was important, and requested the United States, with the assistance of Mexico, to prepare options for consideration by member countries to evaluate Brix data as presented below:

OPTION 1

Rationale: To obtain a Brix number for reconstitution of juice concentrates that, to the extent possible, reflects the actual world mean Brix of the fruit and, thereby, assures that consumers, on the average, are not getting a net water addition to reconstituted fruit juice and that manufacturers, on the average, are not losing solids because of an excessively high Brix number for reconstituted fruit juice.

Method: Employ the following process to determine fruit juice Brix values for those juices for which consensus has not yet been reached.

A. Countries should submit Brix data for individual juices for a minimum of one but preferably three growing seasons. They should include a mean Brix for the growing season that takes into account how much tonnage is actually produced at the various Brix levels throughout the normal Brix range during the growing season, e.g. multiply tonnage by Brix for each week during the season, sum these values and divide by total tonnage.

B. Provide accompanying information on fruit juice production tonnage for each season for each fruit variety.

C. Calculate the Brix value for each fruit juice by each of the following methods.

1. Determine a weighted worldwide average Brix value for each juice by multiplying the individual country mean Brix values by the appropriate tonnage figures, summing these values, then dividing the sum of the Brix/tonnage values by the total tonnage.

2. Proceed as in (1), except, for each country that produces less than 10% of the world tonnage for a specific fruit juice, the tonnage value used in the calculation for that country for that fruit juice would be multiplied by 1.5.

3. Proceed as in (1) above except:

i. For each country that produces more than 5% but less than 10% of the world tonnage for a specific fruit juice, the tonnage value used in the calculation for that country for that fruit juice would be multiplied by 1.5

ii. For each country that produces less than 5% of the world tonnage for a specific fruit juice, the tonnage value used in the calculation for that country for that fruit juice would be multiplied by 2.0.

D. Evaluate the values obtained from the above calculation methods and determine a consensus Brix value for each fruit juice.

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2 For further information on Brix discussion and recommendations of the Drafting Group see CX/FJ 03/3 Appendices I and II. See also ALINORM 03/39-App. III containing the proposed draft revised Codex General Standard for Vegetable Juices.

3 ALINORM 03/39 para. 29.

4 ALINORM 03/39 para. 44.

OPTION 2

An approach, based in statistical considerations, to analyze the information provided by the Codex members, as presented in Appendix I.

OPTION 3

Rationale: A certain Brix level is not a level of exclusion (of a country from the world market), because most of the juice in world trade is concentrated juice and from any lower level of Brix you may reach the concentration established in a Standard.

In the case of directly expressed juices, the Brix level established in the Standard would also be a level of exclusion for those countries unable to reach such a level in its juice production. In this case we are already establishing lower levels of Brix anyhow.

In this option we would ask for the Brix level which would encompass at least 75% of the world production, leaving the other 25% for the market to adjust, as is already done today in the processing plants and across countries, making blends of very low Brix juice with very high Brix juice. The 75% is a value/political judgment used in ABC curves in systems analysis. This percentage could be higher to increase the inclusion to 80% or even more. This would be subject to negotiations to take into account countries with lower Brix levels. The statistical data necessary are the same as in options 1 and 2.

ADDITIONAL OPTIONS

Governments and interested international organizations in Observer status with Codex are encouraged to propose any additional option that is based on the actual Brix of the fruit, that is transparent, that is a method where the data can be treated statistically in an appropriate manner, and that is capable of achieving consensus.

4. The following list identifies direct expressed (DE) and reconstituted (R) juices whose minimum Brix will be resolved by one of the methods described above.

Banana (DE, R)	Lime (R)
Grape (R)	Mandarine/Tangerine (R)
Grapefruit (R)	Mango (RR)
Guava (R)	Orange (DE, R)
Kiwi (R)	Papaya (R)
Lemon (R)	Pineapple (R)

5. Governments and interested international organizations in Observer status with Codex **are invited to:**

a. comment on Options 1, 2 and 3 and to provide any additional option as indicated above;

b. submit directly expressed Brix raw data, tonnage data, and weekly summaries of Brix and tonnage of juices identified in paragraph 4. The data should preferably cover the past three growing seasons but must cover at least one full growing season;

c. comment on whether acid content be used rather than Brix as the reference value for reconstitution in lemon and lime juice. The Drafting Group considered this issue with a proposal that 4,5% acid calculated as citric acid be used as the reference value for reconstitution; and,

d. submit information on acid content for lemon and lime juice, in addition to Brix data.

The options listed in paragraph 3 together with the comments and data submitted on points a), b), c) and d) of this Circular Letter will be considered by the 3rd Session of the Ad Hoc Codex Intergovernmental Task Force on Fruit and Vegetable Juices to be met in May 2003.

APPENDIX I

TECHNICAL NOTE FOR THE INCLUSION OF THE VARIABILITY IN THE CALCULATION OF THE BRIX VALUES

BACKGROUND

The suggested methodology specified in Alinorm 03/39, para. 28 for the calculation of the BRIX values is based on a weighted average where the weights are the percentage of the production of each country with regard to the world production. This proposal does not include in its calculation the variability that the BRIX presents.

In mathematical terms the proposal of the group of the United States is the following:

Be Y^o the standard BRIX that is calculated as

$$Y^\circ = \frac{\sum P_i Y_i}{\sum P_i}$$

Where P_i represents the production of the country i and Y_i is the BRIX average reported by the country i, for i = 1,..., n, where n is the included number of countries.

While $Y°$ is a weighted average with regard to the production, it tends to give a bigger importance to the countries with the largest volume of productions in the world. The mirror group of the United States intends to give an increment to the factor the weights, which can be called a 'handicap', to the countries with small productions.

It is important to point out that the calculation of $Y°$ does not include the variability that the variable BRIX presents.

INCLUSION OF THE VARIABILITY IN THE CALCULATION OF THE STANDARD BRIX

Assuming that the coefficient of variation of the BRIX in the different countries is the same one and that the coefficient of variation of the production among the different countries is the same one, then,

1) The relative error (% of the variable) in the measurement of P_i it is same in all the countries, that is to say, that a confidence interval of longitude of defined by K_p in the country i would be equal to

$$P_i(1 \pm k_p e_p)$$

where e_p is the coefficient of variation of the production.

2) The relative error in the measurement of Y_i is same in all the countries in such a way that an interval of confidence of longitude defined by K_Y in the country i would be equal to

$$Y_i(1 \pm k_Y e_Y)$$

where e_Y it is the coefficient of variation of the BRIX.

Then, the variability of the BRIX can be included in the calculation of the standard BRIX to generate a confidence interval of the following form:

$$\sum_{i=1}^{n} P_i(1 \pm e_P) Y_i(1 \pm k_Y e_Y) = Y^\circ \sum_{i=1}^{n} P_i(1 \pm e_P)$$

$$\Rightarrow \quad Y^\circ = (1 \pm k_Y e_Y) \sum_{i=1}^{n} \frac{P_i}{\sum_{k=1}^{n} P_k} Y_i$$

Therefore, the variability of the BRIX is included in the standard BRIX, $Y°$, starting from the coefficient of variation e_Y and it is necessary to reach an agreement about the e_Y value or, equivalently, on the distribution of BRIX in the world; it is very important to emphasize that e_Y corresponds to the coefficient of variation of the distribution of BRIX at world level, that is to say, the one obtained by considering the worldwide production of orange by instance.

APPENDIX I

BENCHMARKS TO THE STANDARD DEVIATION FROM THE RANGE AND THEIR APPLICATION TO THE INCLUSION OF THE VARIABILITY IN THE BRIX

The coefficient of variation of a variable is defined as the quotient of its own standard deviation divided by its medium. Since the data given by the countries frequently only include the medium, the minimum and the maximum of the BRIX, for different samples of different sizes, it is necessary the application of a rule that relates the range (maximum - minimum) of the BRIX with its standard deviation of this. Fortunately, in Thomson, G.W. (1955) benchmarks are presented for the quotient of the range among the standard deviation that they are applicable for any distribution of which the sample comes (provided the standard deviation and the populational range exist, that which is true for the variable BRIX). If *w* represents the range, *s* the standard deviation and *n* the sample size, then,

$$\frac{w}{s} \leq [2(n-1)]^{1/2}$$

$$\frac{w}{s} \geq \begin{cases} 2[(n-1)/n]^{1/2} & \text{para } n \text{ par} \\ 2[n/(n+1)]^{1/2} & \text{para } n \text{ impar} \end{cases}$$

when clearing *s* in these relationships it is found that

$$s \geq \frac{w}{[2(n-1)]^{1/2}}$$

$$s \leq \begin{cases} \dfrac{w}{2[(n-1)/n]^{1/2}} & \text{para } n \text{ par} \\ \dfrac{w}{2[n/(n+1)]^{1/2}} & \text{para } n \text{ impar} \end{cases}$$

Therefore, starting from the value of the range of the BRIX for a sample is possible to determine minimum and maximum benchmarks for the standard deviation of the BRIX not mattering the populational distribution of the BRIX. Starting from these benchmarks for the standard deviation is possible to determine benchmarks for the coefficient of variation of the BRIX that is needed to include the variability of the BRIX in the calculation of the standard BRIX.

EXAMPLE

Table 1 presents the bench marks for the standard deviation and the variation coefficient for data on the orange production in which each country surrendered as information the values of the minimum, maximum and average of BRIX for samples of different size n_i. The inferior benchmark to the standard deviation of the BRIX is presented in the column with title *d.s.lnf.*, the superior benchmark in the titled column *d.s.Sup.* and, for the variation coefficient, the inferior bench mark is in the column *v.c.lnf.* and the superior bench mark in the column *v.c.Sup.*. The minimum superior benchmark to the coefficient of variation of the BRIX in the table was from 8.99%, and the maximum superior bench mark to the coefficient of variation of the BRIX it was of 29.11%. Similarly, the minimum inferior benchmark to the coefficient of variation of the BRIX in the table was of 0.23%, and the maximum inferior benchmark was of 5.75%.

APPENDIX I

Table 1										
Country	**Year**	**n**	**Minimum**	**Maximum**	**Range**	**Average**	**d.s.Inf.**	**d.s.Sup**	**v.c.Inf.**	**v.c.Sup.**
Brazil	BCR/Flair	45	8.6	14.8	6.2	11.49	0.66	3.13	5.75%	27.28%
	2000	534	8	12.6	4.6	10.2	0.14	2.30	1.38%	22.57%
	2001	371	7.5	11.6	4.1	9.9	0.15	2.05	1.52%	20.73%
	2002	307	9.2	13.2	4	12	0.16	2.00	1.35%	16.69%
Cuba	1995	24	9.5	13.5	4	12	0.59	2.04	4.91%	17.03%
	2000	15	10.1	13	2.9	11.3	0.55	1.50	4.85%	13.25%
Italy	2001	20	10.5	12.7	2.2	11.4	0.36	1.13	3.13%	9.90%
	2002	37	11	13.2	2.2	12.4	0.26	1.11	2.09%	8.99%
Spain	1999	220	9.8	14.2	4.4	11.4	0.21	2.21	1.84%	19.34%
	2000	230	10	14.4	4.4	11.6	0.21	2.20	1.77%	19.01%
	1999	220	9.5	14.5	5	11.8	0.24	2.51	2.02%	21.23%
Argentina	2000	300	8.5	12.1	3.6	10.35	0.15	1.80	1.42%	17.42%
	2001	300	8	12.3	4.3	10.05	0.18	2.15	1.75%	21.43%
	2002	300	9.2	12.2	3	10.44	0.12	1.50	1.18%	14.39%
Florida	2000	23171	8.8	14.4	5.6	11.24	0.03	2.80	0.23%	24.91%
	2001	21848	8.7	14.6	5.9	11.15	0.03	2.95	0.25%	26.46%
	2000	21494	8.8	14.8	6	10.8	0.03	3.00	0.27%	27.78%
South Africa	2002	264	8.4	12.8	4.4	11	0.19	2.20	1.74%	20.04%
Turkey	2000	383	11.2	14.6	3.4	12.3	0.12	1.70	1.00%	13.84%
	2001	549	10.3	13.1	2.8	11.9	0.08	1.40	0.71%	11.78%
Costa Rica	2000	5190	8.49	14	5.51	10.8	0.05	2.76	0.50%	25.51%
	2001	5580	8.19	14.32	6.13	11.36	0.06	3.07	0.51%	26.98%
	2002	6270	7.78	14.16	6.38	10.96	0.06	3.19	0.52%	29.11%

The results of the table 1 can be used to obtain bench marks for the standard deviation and the coefficient of variation of the standard BRIX with joining the samples of each country and calculating the new sample size (the sum of the sizes of the samples of the country), the new average, the new minimum (the smaller than the minima of the samples) and the new maximum (the one bigger than the maxima of the samples). The table 2 presents the results of carrying out this aggregation of the data

Table 2

Country	n	Minimum	Maximum	Range	Average	d.s.Inf.	d.s.Sup.	v.c.Inf.	v.c.Sup.
Brazil	1257	7.5	14.8	7.3	10.60	0.15	3.65	1.37%	34.46%
Cuba	24	9.5	13.5	4	12.00	0.59	2.04	4.91%	17.03%
Italy	72	10.1	13.2	3.1	11.89	0.26	1.56	2.19%	13.12%
Spain	670	9.5	14.5	5	11.60	0.14	2.50	1.15%	21.57%
Argentina	900	8	12.3	4.3	10.28	0.10	2.15	0.99%	20.93%
Florida	66513	8.7	14.8	6.1	11.07	0.02	3.05	0.15%	27.56%
South Africa	264	8.4	12.8	4.4	11.00	0.19	2.20	1.74%	20.04%
Turkey	932	10.3	14.6	4.3	12.06	0.10	2.15	0.83%	17.83%
Costa Rica	17040	7.78	14.32	6.54	11.04	0.04	3.27	0.32%	29.61%

Once obtained the table 2, and with the data of production of each country, it is possible to determine, according to certain approach (it agree among the countries), the variation coefficient to use in the calculation of the standard BRIX that includes the variability of the BRIX. In order to exemplifying, we consider the table 3, where the production of oranges is presented by country elaborated by the FAO and that we locate in the place of Internet www.fred.ifas.ufl.edu/citrus/pubs/ref/acre.htm#t21

Table 3

Country	Average 70-71/ 78-79	Average 80-81/ 88-89	1996-97	1997-98	1998-99	1999-00 Preliminary
	- - - - - - - - - - - - - - - - - - 1,000 metric tons - - - - - - - - - - - - - - - - - -					
USA	8,751.2	7,630.1	11,598.4	12,493.1	8,985.7	11,975.5
Florida[a]	6,952.7	5,503.0	9,332.3	10,054.9	7,666.7	9,593.6
Argentina	771.6	627.6	841.0	921.0	660.0	685.0
Australia	344.0	433.0	556.0	421.0	524.0	600.0
Brazil	6,083.7	10,530.9	16,360.0	18,972.0	15,912.0	17,952.0
China	392.0	407.0	1,850.0	3,203.6	2,724.2	3,420.8
Cuba	133.0	395.2	482.0	460.0	450.0	440.0
Egypt	748.4	1,150.0	1,613.3	1,522.1	1,441.7	1,525.0
Greece	464.6	661.3	995.0	1,000.0	801.0	1,126.0
Israel	1,049.1	815.7	367.2	357.7	220.6	265.0
Italy	1,584.2	1,929.4	2,180.8	2,056.8	1,422.3	1,993.2
Mexico	1,324.4	1,601.9	3,917.0	3,331.0	2,903.0	3,100.0
Morocco	630.3	774.4	766.3	1,119.3	866.9	864.0
South Africa	494.6	564.6	895.0	961.0	989.0	890.0
Spain	1,860.4	1,885.2	2,248.0	2,786.0	2,623.7	2,811.4
Turkey	534.5	688.9	840.0	675.0	780.0	783.0
Venezuela	259.1	386.6	513.7	398.5	331.8	-
Others	6,016.3	8,141.9	10,688.4	11,117.8	11,374.6	11,062.1
WORLD TOTAL	31,441.4	38,623.7	56,712.1	61,795.9	53,010.5	59,493.0

[a]Hardenings included.

SOURCE: FAO, FASS.

For the considered countries, and with those that appear in the table 3, of production (Costa Rica doesn't appear), we obtained, using the preliminary data of 1999-00, the production percentage that would correspond them if the considered countries were the only producers:

Table 4

Country	% Production
Brazil	51.08%
Cuba	1.25%
Italy	5.67%
Spain	8.00%
Argentina	1.95%
Florida	27.29%
South Africa	2.53%
Turkey	2.23%

With the production percentages and the benchmarks for the coefficient of variation of the BRIX for each country it can reach an agreement among the countries on the benchmarks to the variation coefficient to use in the standard that includes the variability of the BRIX. Some possible options are:

1) The benchmarks to the variation coefficient derived of using the weighted average by the percentage of production of the ranges of the BRIX with the respective weighted average of the sizes of the Countries samples.

2) The benchmarks that derived of using the maximum of the ranges of the BRIX of the countries and the respective sample size.

3) The benchmarks derived of using the minimum of the ranges of the BRIX of the countries and the respective sample size.

4) The benchmarks derived of using the range of the BRIX of the country with the biggest sample size.

The standard of punctual BRIX using the weighted average by the production turned out to be similar to 10.93. In the following table the results are shown of each one of the 4 methods proposed for the determination of benchmarks to the variation coefficient to use in the standard of the BRIX that includes the variability of the BRIX Each benchmark of the variation coefficient it was obtained when dividing the benchmark to the standard deviation for the standard of punctual BRIX (10.93)

Table 5

Method	n	Range	d.s.Inf.	d.s.Sup.	v.c.Inf.	v.c.Sup.
1	18899.51	6.31	0.03	3.16	0.30%	28.90%
2	1257	7.3	0.15	3.65	1.33%	33.40%
3	72	3.1	0.26	1.56	2.38%	14.28%
4	66513	6.1	0.02	3.05	0.15%	27.90%

Notice that the values of the reported benchmarks refer to the minimum and the maximum coefficient of possible variation. Another possible agreement point among the countries, apart from the method to use, it will be the value of variation coefficient to use that it is among the obtained benchmarks.

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