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Quality criteria of treacle (black honey)

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Abstract

Treacle, or black honey as so called in Egypt, is one of the important food items for the majority of the population. It is usually produced in small mills, mainly in the private sector, located near the sugarcane cultivation areas. The production process is carried out as a traditional food industry controlled mainly by the experience and practice of the treacle makers. Colour, taste and density define the quality of the product. There are no specific tests or quality parameters used to identify and standardize the quality specifications of treacle, except its gross chemical composition. This study was carried out to propose definite new parameters that can be used to precisely evaluate the quality of treacle. The study reveals five important parameters, out of 10 tested. Good quality treacle must have the following figures for the suggested five calculated parameters: sucrose/reducing sugars ratio (Suc./R. Sug.) 1.5–2, total sugars%/total soluble solids % (T. Sug./T.S.S.) not less than 95, sucrose%/total sugars % (Suc.IT. Sug.) 60–65, reducing sugars%/total sugars% (R. Sug./T. Sug.) 30–35 and reducing sugars/ash ratio (R. Sug./Ash) about 16.

1. Introduction

The Egyptian Organization for Standardization and Quality Control, ES No. 356 (Anon., 1993) defines treacle as: the heavy density sweet liquid, produced by concentrating extracted sugarcane juice, using heat to the extent that liquid does not gain a burnt colour or flavour. Stokes, Coleman, Freeman, and Broadhead (1961) and Broadhead and Zummo (1988) reported that a high quality sugarcane syrup should have no colloidal sedimentation and no crystallization, or if present, limited to a few small crystals.

There are many factors affecting the production of good quality treacle. Some of these factors seem to be practically difficult to control, for example the sugarcane plant variety, agricultural treatments, season, and climatic conditions, especially in the small private sector. Other factors originally in the manufacturing process, utensils and equipment, packing and storage (Johnson & Sturdivant, 1969) can be controlled.

Several authors and standardization organizations have used the gross chemical composition only as a quality criterion for treacle. Their data indicated that there was a broad variation within the main compounds determined. (Abd Allah, 1966; Anon., 1993; Broadhead & Zummo, 1988; Mohamed, 1976). This indicated that the chemical composition of the main components of treacle could not be used alone to determine the quality of treacle.

Therefore, a rigid and clear definition and specification must be established for treacle in order to identify and standardize the main properties of the final product. These properties must include, not only the absolute content of the main components of treacle, but also some other important properties which could be used to predict the interactions and relations between these main components.

These new suggested parameters could be extracted and calculated from the content of the main components of treacle which affects, directly or indirectly, the quality of the final product.

2. Materials and methods

2.1. Materials

Fifteen representative treacle samples were collected as commercially produced samples from the following sources.

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2.1.1. Sugarcane mills samples

Six representative samples were withdrawn from the main sugarcane mills in Upper Egypt. These mills are located in the main treacle producing governorates, namely: El-Minia (Mallawy), Kena (Nag Hammady and Deshna) and Aswan (Edfo). The samples were preserved in covered plastic containers kept in the laboratory at room temperature until analysis.

2.1.2. Market container samples

Market treacle samples were collected from the local market in Alexandria. These samples were classified into two groups according to their size.

1. Large size market container samples: Four different samples were withdrawn from the large containers of 20 kg. The samples were collected from the different districts in Alexandria and stored at room temperature in covered plastic containers until analysis.
2. Small-size market container samples: Five samples, representing the main producers of small-size treacle containers of capacity 2 kg or less, were collected from the local market in Alexandria. All containers were brought to the laboratory and kept at room temperature until analysis.

2.2. Methods

2.2.1. Chemical composition

The following determinations were carried out as described in AOAC (1990): moisture, total soluble solids, total sugars and reducing sugars (using Lane and Eynon titrametric method) and ash. Total solids (%) was calculated as 100 minus moisture content, while sucrose (%) was calculated as (total sugars−reducing sugars)×0.95. All determinations were carried out on wet basis.

2.2.2. Sugaring

The 15 treacle samples tested in the present study were visually inspected for the presence of crystallized sugar. The samples were classified into four sugaring groups, namely as free, light, medium and heavy.

2.2.3. Calculated parameters

Ten different calculated parameters were tested in the present study. These parameters were, the percent of total soluble solids/total solids (T.S.S./T.S.); total sugars/total soluble solids (T. Sug/T.S.S.); reducing sugars (R. Sug.) parameters, including R. Sug. divided by each of T.S., T.S.S. and T. Sug.; Sucrose (Suc.) parameters being Suc. per each of T.S., T.S.S. and T. Sug. as well as Suc. to R. Sug. and R. Sug. to ash ratios.

3. Results and discussion

The results obtained in the present study were compared with the mean values of the chemical composition of two authentic treacle samples which have been reported by Johnson and Sturdivant (1969) and El-Maghraby and Abd El-Aal (1991). The suggested calculated parameters extracted from their data were also used for comparison.

3.1. Chemical composition

3.1.1. Sugaring

The high grade treacle must be free from noticeable sugar crystals precipitated out of the treacle mass. (Broadhead & Zummo, 1988; Stokes et al., 1961). Table 1 indicates that free and medium sugaring were detected within the three sample sources used, while light sugaring was present in two of the small size market container samples. Heavy sugaring was noticed in only one of the mills samples. This revealed that the sugaring was not related to the sample source but mainly related to the treacle composition and/or the relations between its main components.

3.1.2. Moisture, total solids (T.S.) and total soluble solids (T.S.S.)

The moisture content of the tested samples ranged from 22.46 to 25.77%, which was somewhat less than that of authentic samples (mean 26.45%). Correspondingly, the T.S. of the authentic samples mean, 73.55%, was lower than that of the tested samples, ranging between 74.23 and 77.54%. On the other hand, the tested samples, as well as the reference samples, contain a T.S.S. between 70.00 and 72.50%. The value of both moisture and T.S. are within that stated in Egyptian Standards No. 356 (Anon., 1993) while no limits for T.S.S. are mentioned.

3.1.3. Total sugars (T. Sug)

Table 1 indicates that the T. Sug. of the tested samples were between 62.27 and 70.23% with respect to 69.79% for the authentic samples (mean). Also, it could be concluded that there were no correlations between the T. Sug. content and sugaring of treacle. There was a heavy sugaring in the sample containing the minimum T. Sug. (62.27%) while light sugaring was detected in the samples containing the highest mean value of total sugars (70.23%).

3.1.4. Reducing sugars (R. sug.) and sucrose (suc.)

There were large variations in the tested sample contents of both R. Sug. and Suc. Sucrose ranged from 39.9 to 52.3%, while R. Sug. were within 7.18 to 24.1%. It is clear that sugaring increased due to the presence of the high sucrose and low R. Sug. Free sugaring was

Table 1
Chemical composition of treacle

Sugaring groups	Source of samples	Sample no.	Mean chemical composition (Percent on wet basis)						
			Moisture	Total solids (T.S.)	Total soluble solids (T.S.S.)	Total sugars (T. Sug.)	Reducing sugars (R. Sug.)	Sucrose (Suc.)	Ash
Free	Mills	2, 3, 4							
	Large container	7	22.46	77.54	72.50	66.1	24.1	39.9	1.45
	Small container	13, 14							
Light	Mills	–							
	Large container	–	24.77	75.23	71.50	70.2	16.3	51.3	1.55
	Small container	12, 14							
Medium	Mills	1, 5							
	Large container	8, 9, 10	25.77	74.23	70.50	65.9	11.7	51.5	1.72
	Small container	11							
Heavy	Mills	6							
	Large container	–	25.41	74.59	70.00	62.3	7.18	52.3	1.76
	Small container	–							
	Authentic samples (mean)		26.45	73.55	70.70	69.8	23.4	45.3	1.45

observed for the low sucrose (39.9%) and high reducing sugar content samples (24.1%). On the other hand, heavy sugaring was correlated with the high sucrose (52.3%) and low R. Sug. samples (7.18%). This observation importantly leads to the conclusion that the relative amounts of sucrose and reducing sugars are more effective for controlling the sugaring phenomenon than the absolute content of each component alone.

3.1.5. Ash

The total ash content of the tested samples ranged from 1.45 to 1.76%, while that of the authentic samples mean was 1.45. Generally, ash increases the solubility of sucrose and consequently lowers sugaring of treacle (Mathur, 1981).

3.2. Calculated parameters

It can be seen from the above results that the ratios and/or relations between the main components of treacle may affect directly its quality. Ten calculated parameters, shown in Table 2, were suggested to define new quality parameters of treacle. These parameters are now explained.

3.2.1. Total soluble solids % total solids % (T.S.S.%/T.S.%) and total sugar %/total soluble solids % (T. Sug./T.S.S.%)

These two parameters are easily obtained and are affected directly by the moisture content. There was no great variation for T.S.S.%/T.S.%, ranging from 93.50 to 95.04, which was very close to that of the authentic samples mean (96.13). On the other hand, the T.Sug%/T.S.S.% showed somewhat broad variations, ranging from 88.96 to 98.22 with respect to 98.71 for the reference samples. The samples which were described as heavy sugaring, had the lowest value of T. Sug.%/T.S.S.% (88.96), while a high value of the same ratio occurred in samples with less sugaring. The high value of T. Sug./T.S.S. underlines that the total sugars are the most abundant component in the total soluble solids. In other words, this high value indicates that smaller amounts of non-sugar soluble solids are present in these samples. The ratio, T. Sug./T.S.S., could be used as a quality parameter for treacle with a value not less than 95%.

3.2.2. Sucrose parameters

Three sucrose parameters were used, sucrose to each of T.S., T.S.S. and T. Sug. A direct and marked correlation was observed between these three parameters and the sugaring phenomenon that was increased by increasing any one of these ratios. The three parameters of the free sugaring group were 51.4, 55.0 and 60.4%, respectively, for the tested samples. When values of these parameters were increased up to 70.2, 74.8 and 84.1, respectively, a heavy sugaring was noticed. Although all three parameters can be used, the Suc.%/T.Sug.% has the greatest effect. It is therefore proposed that the ratio Suc.%/T.Sug.% within the range 60–65 may be added to the specification of treacle.

3.2.3. Reducing sugars parameters

Three reducing sugar parameters were tested, namely the percent of reducing sugars divided by each of T.S., T.S.S., and T. Sug. Table 2 shows that the values of R. Sug.%/T.S.% were lower than R. Sug.%/T.S.S.%, and the latter lower than R.Sug./T.Sug.% for all the tested and authentic samples. It was also noticed that decreasing of any one of these parameters increases the sugaring phenomenon. No sugaring was observed when the values of these three parameters were 31.1, 33.2, 36.5%,

Table 2
Calculated parameters of treacle

Sugaring groups	Source of samples	Sample no.	Calculated parameter									
			T.S.S./	T. Sug./	R. Sug./			Suc./			Suc/R. Sug.	R. Sug./Ash
			T.S	T.S.S.	T.S.	T.S.S.	T. Sug.	T.S.	T.S.S.	T. Sug.		
Free	Mills	2, 3, 4										
	Large Container	7	93.50	91.1	31.1	33.2	36.5	51.4	55.0	60.4	1.66	16.6
	Small container	13, 14										
Light	Mills	–										
	Large container	–	95.04	98.2	21.6	22.7	23.2	68.2	71.7	73.0	3.15	10.5
	Small container	12, 14										
Medium	Mills	1, 5										
	Large container	8, 9, 10	94.98	93.5	15.8	16.6	17.7	69.3	73.0	78.1	4.40	6.80
	Small container	11										
Heavy	Mills	6										
	Large container	–	93.85	89.0	9.63	10.3	11.5	70.2	74.8	84.1	7.29	4.08
	Small container	–										
	Authentic samples (mean)		96.13	98.7	31.8	33.1	33.5	61.5	64.0	64.8	1.93	16.1

respectively. Light, medium and heavy sugaring occurred when the mean values of these parameters were decreased to about 22, 16 and 10, respectively. This means that any one of these ratios can be used to define sugaring which is one of the most important criteria of treacle quality. The ratio R. Sug./T. Sug. deriving from the most important treacle components, may be effectively used to define a good quality treacle. The value should be 30–35.

3.2.4. Sucrose to reducing sugars ratio (Suc./R. Sug.)

Sucrose and reducing sugars each affect the rate of sucrose crystallization (Baikow, 1982). So the ratio of Suc/R. Sug. is an important criteria for treacle quality. Free sugaring in the samples was observed when this ratio was 1.66. The ratio was about 2 (1.93) for the reference samples. When the ratio was increased to 3.15, 4.40 and 7.29, i.e. sucrose was increased with respect to reducing sugars, a light, medium and heavy sugaring were observed, respectively. The ratio of Suc/R. Sug must be around 1.5 to 2.0 to obtain treacle free from sugaring.

3.2.5. Reducing sugars to ash ratio (R. Sug./Ash)

The sugaring of treacle is affected by the R. Sug./Ash ratio (Table 2). By increasing the value of this ratio, the crystallization of sucrose is inhibited or it even completely disappears. The treacle was described as free from sugaring when this ratio was 16.6 and 16.1 for the tested and authentic samples, respectively. But low values of R. Sug/ash were associated with light, medium and heavy sugaring, these being 10.5, 6.80 and 4.08, respectively. So the R. Sug./ash ratio can be used as one of the treacle quality parameters. The suggested value of the R. Sug/Ash ratio for a good treacle is about 16.

It can be concluded that, beside the gross chemical composition stated in the different treacle specifications, the values of the five suggested calculated parameters ranked in relative importance in the following order have to be added in order to cover the entire spectrum of good quality: 1, Suc./R. Sug. ratio (1.5–2); 2, T. Sug./T.S.S. (not less than 95); 3, Suc./T. Sug. (60–65); 4, R. Sug./T. Sug. (30–35); 5, R. Sug./Ash ratio (about 16).

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