Nutritional Value of Traditional Syrian Sweets and their Calorie Density

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Information on food composition is of great importance for scientists and professionals working in the fields of nutrition and public health. The most apparent role of food composition is to provide the basis for dietary assessment and the formulation of healthier diets. Ready meals and food served in canteens are increasingly included in this approach considering their contribution to daily nutrition. There have been no studies that presented the nutritional values of some traditional Syrian sweets. This study was the first study to shed some lights about the nutritional facts of the traditional Syrian sweets. Seventeen different traditional Syrian sweets both regular calorie content (regular where sucrose was used as sweetener) and reduced calorie content (diet as Aspartame sweetener was used) were analyzed for moisture, ash, carbohydrates, protein and fat content and finally calorie density per 100 g was calculated. The study also measured the calorie content of few sweets which we did not find diet ones similar to them. The results have shown that Syrian sweets in general are very calorie dense foods due to their high content of sugar, fat and other sweeteners such as honey and High Fructose Corn Syrup (HFCS). The calorie density ranges from 347.5 Kcal to 516.2 Kcal per 100 g serving for diet sweets and 372.8 Kcal to 532.2 Kcal per 100 g serving for regular sweets. Protein ranged from 5.6g to 18.4g and fat from 5.5 to 29.8g per 100g serving.

Keywords: Syrian sweets, CHO, Protein, Fat, Baklavah, Mamoul, Kunafeh, Barazek

Introduction
Knowledge of the nutrient content of foods is essential for many types of nutrition research and applied nutrition projects, including the interpretation of food consumption studies, the nutritional assessment of food supplies, and the planning of nutritionally adequate diets. Appropriate nutrient data bases are not always readily available for these activities. Food products require analysis as part of a quality management program throughout the development process, production, and after a product is in the markets. The chemical composition and physical properties of foods are used to determine the nutritive value, functional characteristics, and acceptability of the food product.¹

Food composition data can be very useful in providing information about food composition and estimation of the intake of nutrients. It’s not applicable to analyze the nutrient content of consumed food on large scale although it theoretically can be done.

However, different FCDBs may differ strongly from each other with regard to the nutrients they include.² Furthermore, it
is not always possible to know about the provenance of a certain nutrient in composite foods as in the case of sugar, for instance, wherein the distinction between naturally occurring and added mono- and disaccharides is rather difficult in a mixed diet. However, the content of certain critical nutrients such as added sugars, saturated fatty acids or salt is often used as an indicator of the healthiness of a diet.4,5

Food analysis tables help in translating nutrient-based recommendations into a form that is more applicable by consumers. They also have an important role when it comes to behavioral modifications that are considered a major means for the prevention of overweight and lifestyle-associated health problems. Although recommendations generally refer to food groups as a whole, information on the nutritional quality of individual foods is needed in order to compose a diet designed to meet specific requirements.6

It is possible to show the nutrient contents of food packages by weight unit or portion together with rating systems allowing an easy and quick evaluation of the product, helping consumers to have more choices. Recently, the traffic light system has been in popular in the United Kingdom. Educating consumers to take healthy choices can be done through food labeling by placing simple front-of-package labels appear better suited.7 Using food labeling system is considered beneficial because it influences the choices of food.8,9 Nutrition therapy can use FCDB when planning a meal for certain diseases such as diabetes mellitus or dyslipidemia which require monitoring, inclusion or avoidance of specific nutrients. Information on some nutrients such as carbohydrates, fats are widely available but it is not on other nutrients which have connections with health problems such as fructose, lactose or gluten. McCance long time ago, has established the importance of using reliable data on food composition in therapeutic diets and still till now in use in the UK. However, so far, most FCDBs do not encompass these data or only for some foods.10,11 Plant variety, cultivation and geographical conditions are some environmental factors that can affect the concentration of nutrients in food.12,13 When making nutritional recommendations, it is important to know data on potentially harmful food components such as pesticides, contaminants or by-products of food processing, such as trans-fatty acids or acrylamide.14 Food labels can also provide the basis for recipe reformulation and modifications of production methods aimed at reducing the amount present in food.15 In order to reduce the risk of underestimating exposure that can arise from designating a missing value as null, it is important to complete missing values for specific compounds.16

To makediet version of a certain type of food it needs choosing an acceptable low calorie sweetener or by choosing a way to reduce the calories such as baking versus frying of some snacks. In other cases, low fat ingredients may be used as fat substitutes or by using other reduced-calorie ingredients, such as resistant starch or dietary fiber, to replace part of the food and achieve a more significant caloric reduction.17,18

In this study, we tried to find out if there are foods which had been labeled as diet in our local markets and to determine the difference between those two types with regard to their calorie contents after measuring calories in each sample. Sugars, syrups, molasses, sugar alcohol and honey are all classified as nutritive sweeteners which in addition to their sensation of sweetness, provide bulk energy value and at high concentrations could exhibit preservation action.

However, alternative non-nutritive sweeteners (artificial sweeteners) such as saccharin, aspartame, acesulfame-k and cyclamate are sweetening substances which provide an adequate degree of sweetness to justify their use but they do not utilize in energy metabolism as sucrose.19

The alternative sweeteners may be divided into two broad classes, namely those with a sweetening effect similar to sucrose-bulk sweeteners, and the intense sweeteners. It is of important to refer to the relationship of nutritive sweeteners and obesity.20 The basic cause of overweight is an excess consumption of calories regardless of their source. For those who wish to lose weight, some form of caloric restriction is necessary. Cane and beet sugars accounted in 1982 about 96% of the world’s production of caloric sweeteners and the high fructose corn syrup accounted (HFCS) for the remainder. In United States, HFCS constitutes a large portion of the corn sweetener market. Nutritive and non-nutritive sweeteners, such as aspartame and saccharin, have however become increasingly recognized by consumers for their low or non caloric attributes. United States statistics for 1984 show that within six years consumption trends for non caloric sweeteners were increased. This data, based on the sweetness equivalence to sucrose, highlight the trend of the sweetener market.21

Materials and methods

The study examined 17 traditional Syrian sweets which have been classified into 2 groups according to the type of sweetener used:

Group I: Regular sweets. Sucrose was used as sweetener.

Group II: Diet sweets. Aspartame was used as sweetener.

The study estimated the energy content of the sweets’ samples by chemical analysis. Comparisons were made between Regular and Diet sweets of 11 different types of traditional Syrian sweets which have been purchased from the local market in Damascus, Syria. The performed analysis was; moisture%, ash%, fat%, protein%, CHO% and
then their calories were calculated in serving size of 100g of the sweet sample. Table 1 shows the types of traditional Syrian sweets that have been used in the study.

| Name               | Type of sweets | Picture |
|--------------------|----------------|---------|
| Kol-Washkor        | Diet           |         |
| Baklavah           | Diet           |         |
| Bokaj              | Diet           |         |
| Mabromeh           | Diet           |         |
| Kunafeh Nabelsiah  | Diet           |         |
| Kunafeh Madlouka   | Diet           |         |
| Nut Mamoul         | Diet           |         |
| Pistachio Mamoul   | Diet           |         |
| Date Mamoul        | Diet           |         |
| Awameh             | Diet           |         |
| Nammora            | Diet           |         |

Table 1. Name of the traditional Syrian sweets in the study

Chemical analysis was performed for each sample and repeated 3 times, according to (AOAC, 2002).

- **Moisture determination**
One of the most fundamental and important analytical procedures that can be performed on a food product are an assay of the amount of moisture.

Three grams were weighed into steel plate placed in forced draft oven for 3 hours at 105°C depending on the food sample and its pretreatment.

Moisture % = \( \frac{\text{Weight of wet sample} - \text{wt of dry sample}}{\text{Weight of wet sample}} \times 100 \)

Total solids % = \( \frac{\text{Weight of dry sample}}{\text{Weight of wet sample}} \times 100 \)

- **Ash determination**
Ash is defined as the inorganic residue remaining after incineration or oxidation of food stuff.

Five grams were weighed into porcelain crucibles then placed in the muffle furnace for 5 hours at 550°C. The ash content is calculated as follows:

Ash % = \( \frac{\text{Weight after ashing} - \text{weight of crucible}}{\text{Original sample wt} \times \text{dry matter coefficient}} \times 100 \)

Where: dry matter coefficient = % solids /100

- **Fat analysis: by Soxhlet method**
It is semi continuous solvent extraction. The solvent builds up in the extraction chamber for 5-10 min and completely surround the sample, then siphons back to the boiling flask.

This method provides a soaking effect of the sample and does not cause channeling. Seven grams were weighed into extraction thimble then covered with glass wool.

Fat content is measured by weight loss of the sample or by weight fat removed.

- **Protein analysis: (Kjeldahel method)**
In the Kjeldahel procedure, proteins and other organic food components in a one gram of sample are digested with sulfuric acid in the presents of catalysts.

The total organic nitrogen is converted to ammonium sulfate. The digest is neutralized with alkali and distilled into a boric acid solution.

The borate ions formed are titrated with standardized acid, which is converted to nitrogen in the sample.

The results of analysis represent the protein content of the food since nitrogen also comes from non protein components.

- **Carbohydrates: (by difference)**
Carbohydrates = 100 - (%protein + %fat + %ash + %moisture)

After this chemical analysis, the bomb calorimeter was performed by instrument IKA calorimeter measurement C2000, Germany.

Calorie content was calculated by adding the amount of calories obtained from CHO, protein and fat after multiplying the amount of CHO and protein in grams by 4 and the amount of fat in grams by 9.

**Results and Discussion**
The results obtained from this study are shown in Table 2. Figure 1, shows the calorie content of the diet sweets. The highest Kcal/100 g was in Pistachio Mamoul (516.2 Kcal/100g) followed by date Mamoul (512.4 Kcal/100), Nut Mamoul (448.2 Kcal/100). Awameh and KunafehNabiliah had almost similar calorie content in a serving size of 100 g (424.4 Kcal and 424.1 Kcal respectively).
### Table 2. Chemical analysis and calorie density of different types of Syrian sweets

| Name of sweet       | Type | Moisture (%) | Ash (%) | Fat (%) | Protein (%) | CHO (%) | Calorie per 100 g |
|---------------------|------|--------------|---------|---------|-------------|---------|-------------------|
| Kolwashkor          | D    | 19.3 ± 0.04  | 0.7 ± 0.07 | 5.5 ± 0.05 | 5.6 ± 0.42 | 68.9 ± 0.36 | 347.5 ± 20.2      |
|                     | R    | 16.6 ± 0.05  | 0.7 ± 0.09 | 18.6 ± 0.23 | 8.0 ± 0.81 | 56.1 ± 0.60 | 428.8 ± 25.3      |
| Baklavah            | D    | 16.7 ± 0.37  | 0.6 ± 0.06 | 7.9 ± 0.10 | 11.7 ± 0.92 | 63.1 ± 1.29 | 370.3 ± 19.4      |
|                     | R    | 16.3 ± 0.21  | 0.5 ± 0.10 | 12.3 ± 1.60 | 7.4 ± 0.26 | 63.5 ± 1.61 | 394.3 ± 19.9      |
| Bokaj               | D    | 9.2 ± 0.04   | 0.6 ± 0.04 | 21.3 ± 0.78 | 8.3 ± 0.17 | 60.6 ± 0.85 | 396.2 ± 22.6      |
|                     | R    | 7.9 ± 0.04   | 0.6 ± 0.05 | 18.5 ± 1.30 | 8.7 ± 0.49 | 64.3 ± 1.63 | 458.5 ± 26.1      |
| Mabromeh            | D    | 14 ± 0.05    | 1.5 ± 0.05 | 12.6 ± 0.47 | 14.5 ± 0.41 | 57.4 ± 0.63 | 401 ± 25.3        |
|                     | R    | 14.2 ± 0.03  | 1.3 ± 0.06 | 15.1 ± 0.42 | 9.7 ± 0.45 | 59.7 ± 0.76 | 413.5 ± 26.9      |
| Kunafeh Nabelsiah   | D    | 15.30 ± 0.23 | 0.9 ± 0.09 | 18.1 ± 0.45 | 18.4 ± 0.51 | 46.9 ± 0.91 | 424.1 ± 19.7      |
|                     | R    | 15.09 ± 0.19 | 1.21 ± 0.06 | 19.7 ± 0.65 | 16.5 ± 0.49 | 47.5 ± 1.01 | 433.3 ± 20.1      |
| Kunafeh Madlouka    | D    | 23.11 ± 0.38 | 1.19 ± 0.04 | 15.4 ± 0.46 | 10.9 ± 0.31 | 49.4 ± 0.97 | 379.8 ± 16.3      |
|                     | R    | 20 ± 0.24    | 1.3 ± 0.06 | 14.6 ± 0.38 | 10.2 ± 0.21 | 53.9 ± 1.07 | 387.8 ± 16.9      |
| Nut Mamoul          | D    | 9.3 ± 0.05   | 1.9 ± 0.03 | 19.4 ± 0.44 | 14.3 ± 0.22 | 54.1 ± 1.09 | 448.2 ± 22.1      |
|                     | R    | 4.1 ± 0.12   | 1.6 ± 0.06 | 20.2 ± 0.46 | 13.9 ± 0.48 | 60.2 ± 1.2 | 478.2 ± 24.1      |
| Pistachio Mamoul    | D    | 4.4 ± 0.13   | 0.8 ± 0.01 | 28.6 ± 0.64 | 16.1 ± 0.63 | 51.3 ± 1.1 | 516.2 ± 26.7      |
|                     | R    | 1.3 ± 0.06   | 1.4 ± 0.02 | 28.6 ± 0.73 | 17.4 ± 0.77 | 51.3 ± 1.3 | 532.2 ± 27.4      |
| Date Mamoul         | D    | 5.7 ± 0.15   | 0.7 ± 0.02 | 27.6 ± 0.70 | 9.7 ± 0.03 | 56.3 ± 1.0 | 512.4 ± 20.3      |
|                     | R    | 4.9 ± 0.13   | 1.1 ± 0.01 | 29.8 ± 0.78 | 11.4 ± 0.92 | 52.8 ± 0.62 | 525 ± 22.2        |
| Awameh              | D    | 17.8 ± 0.27  | 0.6 ± 0.01 | 20.4 ± 0.55 | 7.2 ± 0.12 | 53 ± 0.71 | 424.4 ± 24.2      |
|                     | R    | 18.4 ± 0.29  | 0.9 ± 0.04 | 15.8 ± 0.44 | 7.9 ± 0.14 | 57 ± 0.71 | 401.8 ± 19.9      |
| Nammoura            | D    | 19.6 ± 0.31  | 1.1 ± 0.05 | 10.4 ± 0.17 | 6.1 ± 0.11 | 62.8 ± 1.09 | 369.2 ± 17.6      |
|                     | R    | 20.4 ± 0.32  | 0.9 ± 0.02 | 11.6 ± 0.19 | 7.6 ± 0.12 | 59.5 ± 1.06 | 372.8 ± 20.1      |
Calorie density of the regular sweets is presented in Figure 2. Results have shown that Mamoul sweets (date and pistachio) had similar calorie and they were the highest in terms of Kcal/100 g. The lowest calorie content was KunafehMadluka (387.8 Kcal/100 g). The reason behind the decline in calorie content compared to other types of sweets was its high moisture content.

With regard to the ash content of the diet sweets, Nut Mamoul had the highest ash content (1.9 g/100 g serving) followed by Mabroumeh (1.5 g/100 g). The lowest ash content was in Awameh and Bokaj (0.6 g/100 and 0.9 g/100 g respectively) (Figure 5).

When compared the diet sweets in terms of their moisture content, the study found that Kunafeh Madluka has the highest moisture content (23.11%) followed by Namoura and Kol Washkor (19.6% and 19.3% respectively). The lowest moisture content was in Pistachio Mamoul. The lowest moisture content is found in different types of Mamouls (dates, nut and pistachio) and the same is shown in regular sweets. This is explained through Figures 3 and 4 why Mamouls are rich in calorie.

Whereas, the highest ash content in the regular sweets was in Nut Mamouls (1.6 g/100 g serving) and the lowest was in Baklavah(0.1g/100g serving) (Figure 6). The high protein content in Mamoul can be attributed to their nut content which is about 50% of their dry weight.

Figure 7 shows the fat content in the diet sweets. The highest fat content of the sweet was in Nut and Pistachio Mamouls followed by Bokaj, Awameh and KunafehNabulsiah. The variations in fat content are mainly due to the amount of butter oil used in making sweets and this could be individual variations during preparation.
In the regular sweets, the highest fat content was in Dates and Pistachio Mamouls (29.8g/100 g and 28.6g/100 g respectively) and the lowest was in Baklava and Namoura (1.6 and 0.9g/100 g serving size) (Figure 8).

Syrian sweets are not rich in calories but in protein too. Figure 9 shows the protein content of the diet sweets. The highest protein content was in KunafehNablsiah(18.4g/100 g) followed by Pistachio Mamoul (16.1g) and Mabroumeh (14.5g). The lowest content was in KolWashkor (5.6g/100g). The reason behind the result is the use of cheese in making Kunafeh Nabsiah.

When it comes to CHO content of the diet Syrian sweets, there was no difference between most sweets. CHO content ranges from 46.9 g to 68.9 g per 100 g serving size. The highest was in KolWashkor (68.9g/100) and lowest was in KunafehNablsiah(46.9 g/100). Moisture content played an important role in increasing or decreasing CHO content. The same can be seen in regular sweets and their CHO content. The difference between different types of sweets was minimal as demonstrated in Figures 11 and 12.
Figures 14 and 15 showed the CHO content and the calorie density of the regular sweets. Almost all sweets had similar content. The CHO content ranges from 55% to almost 80%. The highest was plain and sesame Kaak followed by Harriseh. The calorie density of the regular sweets is very close to each other. The highest calorie density is found in Ghoribah and Barazek (450 g/110 g and 440 g/100g) followed by seasame Kaak, plain Kaak and the lowest was in Halawa BilJibn and Harrisah. The reason behind increasing the calorie density in Ghoribah and Barazek is the low moisture content and having ingredients such as sesame and butter oil when making them.

Table 3. Chemical analysis of some other regular sweets

| Name of sweet              | Picture | Moisture (%) | Ash (%) | Fat (%)  | Protein (%) | CHO (%)  | Kcal per 100 g |
|----------------------------|---------|--------------|---------|----------|-------------|----------|----------------|
| Barazek                    | ![Image](https://example.com/image1.png) | 13.3±1.7c | 1.3±0.2c | 19.8±4.4b | 13.1±3.1b | 52.5±11.3f | 440.6±19.4b   |
| Ghoribah                   | ![Image](https://example.com/image2.png) | 12.6±2.1d | 1.9±0.3d | 21.6±4.7a | 9.1±2.6c  | 54.8±11.7e | 450±20.1a     |
| Plain Kaak (bread stick)   | ![Image](https://example.com/image3.png) | 8.6±1.2a  | 1.4±0.2a | 9.6±2.7b  | 1.7±0.3a  | 78.7±12.6a | 408±16.7d     |
| Sesame Kaak (bread stick)  | ![Image](https://example.com/image4.png) | 6.2±0.9f  | 1.6±0.2b | 10.8±2.8c | 4.6±1.1d  | 76.8±11.8b | 422.8±19.1c   |
| Halawa BilJibn (Pastries filled in cheese) | ![Image](https://example.com/image5.png) | 15.4±2.1b | 0.8±0.1d | 8.9±1.2e  | 15.4±3.5a | 59.5±12.2d | 379.7±13.7e   |
| Harriseh                   | ![Image](https://example.com/image6.png) | 15.7±1.9a | 1.3±0.08e| 8.2±1.1f  | 1.1±0.04f | 73.7±10.2e | 373±12.5f     |

Different letters denote significant difference (P<0.05)

Figure 13. Moisture content in regular sweets

Figure 14. CHO content in regular sweets

Figure 15. Calorie content of regular sweets

Figure 16 shows a comparison between diet and regular sweets. All sweets except Awameh, their diet version had less calorie content. This is due to use artificial sweeteners such as aspartame but in case of Awameh, the explanation of why diet Awameh had more calorie had several reasons. The best is the change of ingredients such as fat or the type of flour used in preparation.

Conclusion

The results obtained from this study are not conclusive because in every region of Syria, there are some variations in the recipes during preparation of the sweets. These variations are reflected in the nutritive value of such sweets and their calorie content. Therefore, this study offered the first step towards appreciation of the nutritive value of the traditional Syrian sweets. The data are very helpful for diet professionals and for the public who are looking after their health.

The traditional Syrian sweets are very rich in nutrients such as fat, protein and sugars. They also contain high caloric values per serving (Kcal/100g). People with compromised health status should always take into consideration these values as prevention of certain diseases such as diabetes.
Especially for those who want to reduce weight or to maintain their body weight. Cholesterol problem is another issue as the tradition Syrian sweets are high in saturated fatty acids is recently trans-fats have been used to replace animal fats because they are cheaper but they can cause severe health problems. Consumers should be aware of this information.

**Recommendations**

As this study has shown that the Syrian sweets are rich in calories and other nutrients such as fat, protein and carbohydrates. People should be aware of what they eat especially in terms of how many calories in the serving size they eat. In addition to the amount of grams of fat in their sweet treat. Syrian sweets contain at least 3 serving size of CHO and sometimes around 4 which equals 45 to 50 grams of sugar per 100 grams of sweets. Being aware of these numbers, person can maintain his/her healthy weight and even can reduce it.

Knowing the fat amount will not only good for healthy weigh but for health heart. High fat intake mainly saturated fat and trans-fats are not good for heart health.

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**References**

1. Greenfield H, Southgate DAT. Food Composition Data 2nd Edition: Production, Management and Use. Elsevier Science Publishers, FAO, Rome. 2003.

2. Nielsen SS. Food analysis. Third Edition, Springer, USA. 2003.

3. Institute of Food Technology. Effect of food processing on nutritive values. Food Technol 1986; (12): 109-116.

4. Livingstone MB, Rennie KL. Added sugars and micronutrient dilution. Obees Rev 2009; 1: 34-40. doi: 10.1111/j.1467-789X.2008.00563.x.

5. Matthew AF. Energy content in a candy bar. Cal Poly University’s Journal 2009; 1132: 23-31.

6. Lobstein T, Davies S. Defining and labelling ‘healthy’ and ‘unhealthy’ food. Public Health Nutr 2009; 12(3): 331-340.

7. Grunert and Wills. A review of European research on consumer response to nutrition information on food labels. Journal of Public Health 2007; 15(5): 385-399

8. Pietinen P, Patruni M, Reinvuo H et al. FINDIET 2007 Survey: energy and nutrient intakes. Public Health Nutr 2010; 13(6A): 920-924. doi: 10.1017/S1368980010001102.

9. Variyam JN. Do nutrition labels improve dietary outcomes? Health Econ 2008; 17(6): 695-708.

10. Meirelles A, Handwerk R. Dietary Fructose and Glucose Differentially Affect Lipid. The Journal of Nutrition 2009; 139. 1257S-1262S.

11. Zimmerman TP, Hull SG, McNutt S et al. Challenges in converting an interviewer-administered food probe database to self-administration in the National Cancer Institute Automated Self-administered 24-Hour Recall (ASA24). J Food Compost Anal 2009; 22(1): S48-S51. doi:10.1016/j.jfca.2009.02.003

12. Hyvonen L. Synergism between sweeteners. In: Carbohydrate sweeteners in foods and nutrition. Koivstionen P. Hyvonen L. (Eds) Academic, London. 1980.

13. Fogliano V, Maiani G, Quaglia G. Seasonal variations in antioxidant components of cherry tomatoes (Lycopersicones culentum cv. Naomi F1). Journal of Food Composition and Analysis 2006; 19(1): 11-19.

14. Jakszny P et al. Development of a food database of nitrosamines, heterocyclic amines, and polycyclic aromatic hydrocarbons. J Nutr 2004.

15. Birlouez-Aragon I, Saavedra G, Tessier Fj et al. A diet based on high-heat-treated foods promotes risk factors for diabetes mellitus and cardiovascular diseases. Am J Clin Nutr 2010; 91(5): 1220-1226. doi: 10.3945/ajcn.2009.28737.

16. Merchant AT, Dehghan M. Food composition database development for between country comparisons. Nutr J 2006; 19(5): 2.

17. Grenby TH. Intense sweeteners for the food industry. An overview. Trends in food Sci and Tech 1991; 2(1): 2-6.

18. Branan AL, Davidson PM, Saminene G. Food Additives, Sweeteners. Marcel Dekker, INC,N.Y and Basel, Chapter 1990; 8: 297-323.

19. Giese JH. Alternative sweeteners and bulking agents. Food Technology 1993; 47(1): 114-126.

20. Franta R, Beck B. Sweeteners. Alternative to cane and beet sugar. J Food Techno 1986; 40(1): 116-128.

21. Lecos CW. Sweetness minus calories- controversy. FDA Consumer, 1985; 19(2): 18.

22. A.O.A.C. Official Methods of Analysis. 17th ed. Association of Official Analytical Chemists, Published by the Association of Official Analytical Chemists, Inc. USA. 2002,