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Microbiological and Physiochemical Quality Assessment of commercially produced Biscuits and cake available in Sana'a, Republic of Yemen

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Abstract

Biscuits and cake of different brands, are imported from many countries around the world, and distributed over all Yemeni markets. The aim of this study is to determine the Physiochemical deterioration and microbial contamination of the cake and biscuits products of different commercial brands distributed in Yemeni markets according to Yemen Standardization and Metrology Organization (YSOM) Standards. A total of 83 samples from these two categories were selected to study for their Physiochemical and bacteriological properties. Where 18 Physiochemical and 5 bacterial tests has been done following the standard methods. All the test results were compared with YSOM Standards to their acceptability for human consumption. The physiochemical results showed that 9 samples were discrepant to YSOM Standards in their net weight and color, 10 samples were low quality as result to their moisture, 9 samples were shows non-homogenous in their texture, 3 samples showed irregular shape. 14 samples had broken parts, 14 samples were had bad package sealing, stick in to their sealing cover and design defect, 6 samples were not acceptable as result to their rancid smell, 10 samples contained foreign materials, burn and insect infestation, 23 samples had unacceptable levels of Aspartame, Saccharin and Acesulfame-K content respectively, compared with YSOM standards. 11 samples were showed high sorbic acid contain than YSOM permissible limit, 13 samples which have higher content of Cu, 4 samples were not acceptable as result to their fatty acid content and finally 22 samples were having increase amount of acid insoluble ash higher than the acceptable limit according to YSOM. The microbiological results of 16 samples were not acceptable due to their contamination by *Staphylococcus aureus*, *Bacillus cereus* and *Escherichia coli* O157:H7 respectively. All samples were free of *Salmonella* spp.

Keywords: Physiochemical properties, bacteriological properties, biscuits, cake, and YSOM standards.

Introduction

Bakery products are popular food consumed worldwide, it is a source of different nutrients such as carbohydrates, proteins, lipids, vitamins and minerals (Potter and Hotchkiss 2006; Saranraj and Geetha, 2012). Biscuits and cake are the most popular bakery items because of their high nutritive value, ready-to-eat nature, and easy availability in different shapes and sizes at an affordable cost. Challenges in the cake market include cost reduction, increased shelf life and quality control (ISIRI, 2014).

Confectionary products (sweets) form an important part of a balanced diet. The products due to form by eggs and milk nutrients, is a suitable vector for microbes and bacteria (Smith et al., 2004). Spoilage of bakery and confectionary products are three types that include microbial spoilage, physical and chemical spoilage. Microbial spoilage has importance in terms of health and economic matters time during storage confectionary products cause outbreaks of food poisoning (Smith *et al*., 2004). Freshly baked goods are sterile and free of living germs, but they quickly get contaminated when exposed to air and surfaces (Ballester-Sánchez, J., et al., 2019). Contamination also occurs, after baking process, during the production steps such as cooling, slicing (unhygienic handling), transport, and packing as well as storage (Todd, E.C., 1997).

Yemen Standardization and Metrology Organization (YSOM) defined biscuits as "a food product prepared essentially from wheat flour, edible fat substance, edible common salt, and water with or without the addition of the optional ingredients", and according to Yemeni Standard biscuits could be divided in to plain, filled, ands coated biscuit, as well as wafer (YSOM, 2012). Cakes is a type of sweet bakery products with specific texture and softness, which its main ingredients are flour, oil, sugar and eggs, each of which plays an important role in the structure and quality of the product (Rodríguez-García *et al*., 2012). Biscuits, cakes and other sweet baked items are rich in sugar (mainly sucrose) and fat and are usually avoided by calorie-conscious consumers (Zoulias *et al*., 2000). The substances used to replace sugar are called alternative sweeteners or sugar substitute. These alternative sweeteners either could be from a natural source or artificially derived by chemical synthesis. These artificial sweeteners are chemically different from the sucrose or other natural sweeteners that they are replacing in a food system.

Therefore, it is very important to understand their Physiochemical properties, taste characteristics and stability for formulation, processing and storage (Nelson, 2000). Aspartame, acesulfame K, advantame, alitame, cyclamate, neotame, saccharin and sucralose are among the commonly reported artificial sweeteners replacement. Among the artificial sweeteners saccharin, cyclamate and aspartame are considered as first generation sweeteners, whereas, acesulfame-K, sucralose, litame, advantame and neotame are new generation sweeteners (DuBois and Prakash, 2012). Low calories food available to consumer shelves on the market are products prepared with low energy sweeteners. These products are very popular among weight and health conscious consumers (Abdullah and Cheng, 2001).

Objectives cake and biscuits are among perishable food items and according to their ingredients and high potential contamination and deterioration the microbes and fungi and thereby increase the risk of food poisoning, this study were aimed to determine the to evaluate the bacteriological quality and safety practices for consumptions of biscuits and cake of different commercial brands which are distributed in Yemeni markets (Sana'a city) according to (YSOM) Yemeni Standard Organization Metrology.

Materials and methods

Sample collection:

The samples collected for this study were taken in their original packaging from commercially available different supermarkets in Sana'a city during the year 2022. A total of 83 samples (62 of biscuits and 21 cakes) of different brands were instantly transported to the laboratory at the same city to and bacteriological examination. All the sample products were whiting valid date of expire.

Analysis of the samples

Physiochemical analysis:

All samples were analyses using different 19 Physiochemical tests such as Net weight, Moisture, Texture, Broken parts, package sealing, Design defect, Rancid smell, Foreign materials and burn, Insect contamination, Aspartame, Sorbic acid, Saccharin**,** Acesulfam-k, Cu, Ash acid insoluble, fatty acid as oleic acid, Color and Stick with the cover. All the Physiochemical analysis

were done following standard methods prescribed by YSMO GSO 989 :2012, YSMO GSO 104 :2006, YSMO GSO 1320 :2012 and YSMO GSO 263 /2012, YSMO GSO 567 /2012 and YSMO GSO 995 /2012, for biscuits and cake, for sweeteners respectively.

Samples preparation for bacteriological analysis:

Samples prepared in accordance with the YSOM standard appropriate to the product concerned. Eleven grams of each sample were homogenized with 99 ml peptone water (under sterile conditions). From this suspension, decimal dilutions in peptone water were prepared and spread on the appropriate plates, according to Harrigan and McCance (1976).

Bacteriological analysis:

5 main bacteriological groups in all samples has been evaluate according to methods prescribed Yemeni Standard Organization Metrology (YSOM), Enterobacteriaceae (YSMO GSO ISO 4832:2012), *Salmonella spp.* (YSMO GSO 287/2012), *Bacillus cereus* (YSMO 1531/2006), *Staphylococcus aureus* (YSMO GSO 711/2012), *Escherichia coli* 0157:H7 (YSMO 2071/2008).

Results and discussions

a- Physiochemical tests:

1- **Net weight: net weight shall be clearly specified and the measurement or quantity so specified shall not be lesser in any case (ILSI, 2013). An each sample in the present study was** having its own net weight according to the products types lapelled**.** The net weights of all samples studied were allowed and standard (Table 7) except B23, B38, SC4 samples, which were having less net weights (Table1and 2).

2- **Color (except for biscuits): Color of a baked product is directly dependent on the colors of the raw materials used (Ewelina Zieli ´nska and Urszula Pankiewicz,** 2020). The color of all product samples studied were general acceptability according to their original product this study is similar finding of Omoba et al.; 2013 and Ajanaku; 2011, except for some samples SC2 (Table 2).

3- **Moisture: Moisture content is a significant quality factor affecting preservation, packaging, and transport convenience (Kaur, M et al., 2017) and the Moisture can interfere on sensorial attributes of melting and texture (Calionara et al., 2020).** The net Moisture of all samples

studied were allowed and standard (Table 9) except B1, B5, B6, B60 and B61 samples (Table1).

4- **Texture:** The texture, appearance, and storage stability are very importance factors which can influence consumer perception of candy (Juzhong Tan and William L. Kerr, 2017). All the samples studied shows homogenous in their texture (Table 7) except B4, B17, B38, B49, SC2, SC4 and SC12 samples (Table1 and 2).

5- **Shape:** All the samples studied of biscuit and cake show regular shapes according to YSOM.

6- **Broken parts:** The broken pats of all samples studied were within the acceptable limits and standard except B8, B17, B19, B25, B30, B33, B60, SC1, SC4, SC7, SC12, SC17 and SC20 samples (Table1 and 2).

7- **Package sealing:** All the samples studied were packed and sealed properly except B4, B17, B49, SC2 and SC4 (Table1 and 2).

8- **Sticking of sample with backing cover:** no any test samples were stick in to their sealing cover.

9- **Design defect:** Most of the samples studied did not show any defect in their design except B4, B17 and B49 samples (Table 1 and 2).

10- **Rancid smell:** All the samples studied were having acceptable smell according to their brand products except B3, B49, SC2, SC4 and SC12 samples (Table1 and 2).

11- **Foreign materials and burn:** few of test product were not free from foreign materials and burn B2, B4, B17, SC2 and SC4 samples (Table1 and 2).

12- **Insect infestation:** only four biscuits and cake products samples (two from each) were having insect **infestation** B4, B38, SC2 and SC12 samples (Table1 and 2) while other samples did not showed any insect **infestation**.

13- **Aspartame:** Aspartame (E951) is a synthetic, dipeptide, intense sweetener, which is almost 180-200 times sweeter than sucrose, with a respective low calorific value. Aspartame is widely used in more than 6000 products worldwide with a huge commercial outcome under many brand names (Prioritization, 2009). Aspartame is very much popular owing to its reduced costs, low caloric intake, attractive advertisements and assurance to contribute in weight management. The popularity of aspartame among consumers lies down within the problems associated

with sucrose consumption [Tandel KR (2011)]. B5, B46 and SC3 samples studied were having Aspartame (Table1, 2) that were unacceptable (Table 7) while other remaining sample were free from Aspartame contents.

14- **Sorbic acid:** Sorbic acid is a natural organic acid added to food and beverages as a preservative agent. Although sorbic acid is widely used as a mold inhibitor in a variety of foods, an off-odour might develop due to the catabolism of sorbic acid by sorbate resistant strains of yeasts and molds (O. Gürbüz et al., 2011). Some of studied samples B15, B19, B39, B47, SC2, SC4, SC9, SC10 and SC15 were showed high Sorbic acid contain than permissible limit such as (Table1, 2).

15- **Saccharin:** Saccharin is chemically known as o-sulfabenzamide (2, 3-dihydro-3-oxobenzisosulfonazole). It is sulphonamide derivative of toluene and available as acid saccharin, sodium saccharin and calcium saccharin (DuBois and Prakash, 2012). Few samples of each brand product studied were having unacceptable Saccharin B16, B37, B51, SC5, SC12, SC13 (Table1, 2) and (Table 9).

16- **Acelfame- K**: Acesulfame is an oxathiazinone dioxide (6-methyl-1, 2, 3-oxathiazine-4(3H)-one-2, 2, dioxide or 3, 4-dihydro-6-methyl-1, 2, 3-oxathiazin-4-one-2, 2-dioxide). Chemically, it bears some structural resemblance to saccharin. it is sold as potassium salt, so it often referred to as "acesulfame-K" (Walters, 2013). Few studied samples B22, B31, B50, B54, B60, SC6, SC18 (Table1, 2) were having more than the acceptable limit of Acesulfame- K content (Table 7) while most of the remaining samples were free of Acesulfame- K content.

17- **Cu**: The concentration of Cu in all studied samples were within the acceptable ring (Table 7) except B3, B27, B42, B59, SC2 and SC14 (Table1, 2,) which have higher content of Cu.

18- **Fatty acid as oleic acid (for cake):** All studied samples were showed normal contains of fatty acid as oleic acid (Table 7) except SC2, SC3, SC12 and SC13 samples (Table 2).

19- **Percentage of insoluble Ash acid:** Ash is an inorganic substance left over from the combustion of an organic material. The ash content and composition depend on the type of material and the method of ashes (Sudarmadji et al. 2007). Few studied samples of different brand products

B2, B19, B21, B22, B26, B27, B61, SC2, SC3, SC10, SC12, SC14 andSC20 (Table1, 2) were having increase amount of insoluble Ash acid higher than the acceptable limit (Table 7), while the remaining samples were free **insoluble Ash acid**.

Table (1) Shows the Physiochemical tests of the different commercial types of studied biscuits samples during 2022

samples	Types of biscuits	Net weight (gm)	Moisture (%)	Texture	Broken parts (%)	package sealing	Design defect	Rancid smell	Foreign materials and burn	Insect contamination	Aspartame (ppm)	Sorbic acid (%)	Saccharin (ppm)	Acesulfam-k (ppm)	Cu (ppm)	% of Ash acid insoluble
B1	Biscuit with Marshmallow	55.55	6.7	homogenous	0	Sealed	0	free	Free	free	0	0	0	0	1.90	0.04
B2	Wafer with milk chocolate	17.76	8.9	Homogenous	1.1	Sealed	0	not	Not	free	0	0	0	0	2.70	1.01
B3	Plain wafer	16.4	2.5	Homogenous	0	Sealed	0	free	Free	free	0	0	0	0	3.10	0.07
B4	biscuit with chocolate cream	40	6.7	Not	1.07	Not	10.5	free	Not	Not	0	0	0	0	1.46	0.09
B5	Biscuit with coconut and cream	72.13	10.9	Homogenous	3.3	Sealed	0	free	Free	free	6.3	0.2	0	0	1.83	0.03
B6	Wafer with milk	50.36	13.6	Homogenous	4.6	Sealed	0	free	Free	free	0	0	0	0	0.44	0.02
B7	biscuit With vanilla cream	22.62	9.8	Homogenous	5.3	Sealed	0	free	Free	free	0	0	0	0	0.56	0.01
B8	Wafer with coconut and chocolate	27.4	3.1	Homogenous	1.01	Sealed	0	free	Free	free	0	0	0	0	1.68	0.03
B9	Wafer with crispy rice and chocolate	29.61	1.3	Homogenous	2.05	Sealed	0	free	Free	free	0	0.1	0	0	2.23	0.05
B10	Wafer with milk cream	44.49	3.3	Homogenous	o.7	Sealed	1.3	free	Free	free	0	0	0	0	0.61	0.10
B11	Wafer with nut cream	43.53	4.1	Homogenous	3.1	Sealed	0	free	Free	free	0	0	0	0	1.53	0.02
B12	Crispy Wafer with cream flavor	45.66	3.09	Homogenous	2.1	Sealed	0	free	Free	free	0	0	0	0	3.28	0.04
B13	sandwich Biscuit	118.06	13.3	Homogenous	1.3	Sealed	0	free	Free	free	0	0	0	0	1.9	0.01
B14	Plain Biscuit	179.7	3.38	Homogenous	0.9	Sealed	0	free	Free	free	0	0	0	0	2.77	0.05
B15	Wafer with strawberry flavor	19.66	0.1	Homogenous	0.5	Sealed	0	free	Free	free	0	1.3	0	0	1	0.02
B16	Plain Biscuit	8.6	4	Homogenous	0.01	Sealed	0	free	Free	free	0	0	5.4	0	2.1	0.01
B17	Filled Wafer	25.82	0.05	Not	5.2	Not	10.8	free	Not	free	0	0	0	0	5.2	0.5
B18	Filled biscuit	108.85	1.3	Homogenous	3.3	sealed	0	free	Free	free	0	0	0	0	2.11	0.02
B19	Plain biscuit	48.56	0.7	Homogenous	6.95	sealed	0	free	Free	free	0	1.2	0	0	2.6	1.10
B20	Filled biscuit	25.32	0.3	Homogenous	0	sealed	0	free	Free	free	0	0	0	0	0.26	0.03
B21	biscuit Filled custard flavor	24	1.3	Homogenous	0.3	sealed	0	free	Free	free	0	0	0	0	0.23	1.04
B22	Wafer With Marshmallow	9.55	2.1	Homogenous	0	sealed	3.2	free	Free	free	0	0	0	3.6	0.32	1.01
B23	Plain biscuit	41.53	1.2	Homogenous	0	sealed	0	free	Free	free	0	0	0	0	0.2	0.02

samples	Types of biscuits	Net weight (gm)	Moisture (%)	Texture	Broken parts (%)	package sealing	Design defect	Rancid smell	Foreign materials and burn	Insect contamination	Aspartame (ppm)	Sorbic acid (%)	Saccharin (ppm)	Acesulfam-k (ppm)	Cu (ppm)	% of Ash acid insoluble
B24	Wafer with chocolate	35.22	3.1	Homogenous	1.3	sealed	0	free	Free	free	0	0	0	0	2.22	0.01
B25	Wafer Filled chocolate	46.42	3.7	Homogenous	6.04	sealed	0	free	Not	free	0	0.1	0	0	1.99	0.06
B26	Wafer Filled chocolate	84.08	5.4	Homogenous	2.3	sealed	0	free	Free	free	0	0	0	0	1.97	1.09
B27	Plain Biscuit	119.14	4.1	Homogenous	1.3	sealed	0	free	Free	free	0	0	0	0	3.7	1.02
B28	Wafer with chocolate	60.25	2.1	homogenous	2.05	sealed	1.4	free	Free	free	0	0	0	0	2.19	0.06
B29	Wafer Filled dates	85.13	1.1	homogenous	0.7	sealed	0	free	Free	free	0	0	0	0	2.08	0.01
B30	Wafer Filled chocolate and nut	495.4	1.4	homogenous	5.1	sealed	0	free	Free	free	0	0	0	0	0.26	0.05
B31	Plain Wafer	32.03	0.5	homogenous	1.4	sealed	1.5	free	Free	free	0	0	0	11.1	1.7	0.04
B32	biscuit Filled chocolate cream	153.1	3.1	homogenous	3.4	sealed	0	free	Free	free	0	0	0	0	2.76	0.02
B33	biscuit Filled chocolate cream	39.1	2.4	homogenous	2.9	sealed	0	free	Free	free	0	0	0	0	5.8	0.09
B34	Filled Wafer	38.22	3.3	homogenous	0.7	sealed	0	free	Free	free	0	2.7	0	0	2.16	0.3
B35	Filled Wafer	87.4	2. 8	homogenous	1.2	sealed	0	free	Free	free	0	0	0	0	0.39	0.6
B36	crispy wafer with caramel	24.5	0.9	homogenous	0.5	sealed	3.3	free	Free	free	0	0	0	0	1.71	0.11
B37	Biscuit with strawberry cream	68.6	2.01	homogenous	0	sealed	0	free	Free	free	0	0	6.3	0	0.57	0.65
B38	Biscuit with dates	78.08	1.1	not	3.2	sealed	0	free	Free	Not	0	0	0	0	1.33	0.03
B39	Biscuit with caramel and milk	38.9	2.1	homogenous	4.9	sealed	0	free	Free	Free	0	0.8	0	0	0.66	0.06
B40	biscuit with orange flavor	78.21	2.08	homogenous	0	sealed	2.1	free	Free	Free	0	0	0	0	0.95	0.08
B41	Sandwich biscuit with Marshmallow and coconut	49.23	1.2	homogenous	2.2	sealed	0	free	Free	Free	0	0	0	0	1.56	0.2
B42	Sandwich biscuit with cream	141	3.11	homogenous	1.6	sealed	0	free	Free	Free	0	0	0	0	10.62	0.08
B43	Chocolate biscuit Filled cream	65.4	1.24	homogenous	0	sealed	0	free	Free	Free	0	0	0	0	1.64	0.02
B44	biscuit with Marshmallow coated banana cocolin	10.64	16.9	homogenous	3.2	sealed	0	free	Free	Free	0	0	0	0	1.26	0.05
B45	biscuit with chocolate	29.59	7.8	homogenous	2.56	sealed	2	free	Free	Free	0	0	0	0	1.07	0.02
B46	biscuit with coconut	44.69	2.4	homogenous	4.5	sealed	0	free	Free	Free	8.3	0	0	0	1.94	0.004
B47	biscuit with chocolate and vanilla flavor	57.15	3.1	homogenous	1.1	sealed	0	Free	Free	Free	0	2.4	0	0	2.62	0.02
B48	Plain biscuit	18.01	2.78	homogenous	2.3	sealed	0	Free	Free	Free	0	0	0	0	1.45	0.03
B49	biscuit Filled flavor	92.07	1.9	not	0	not	10.5	Free	Free	Free	0	0	0	0	1.41	0.03
B50	biscuit with orange flavor	89.5	3.01	homogenous	0	sealed	0	Free	Free	Free	0	0	0	3.7	0.55	0.02

samples	Types of biscuits	Net weight (gm)	Moisture (%)	Texture	Broken parts (%)	package sealing	Design defect	Rancid smell	Foreign materials and burn	Insect contamination	Aspartame (ppm)	Sorbic acid (%)	Saccharin (ppm)	Acesulfam-k (ppm)	Cu (ppm)	% of Ash acid insoluble
B51	biscuit Filled chocolate	53.43	2.5	homogenous	1.3	sealed	0	Free	Free	Free	0	0	6.1	0	1.61	0.9
B52	Crispy Wafer with chocolate flavor	16	5.6	homogenous	0	sealed	0	Free	Free	Free	0	0.2	0	0	2.79	0.9
B53	Wheat quaker with chocolate and nut	82.8	9.1	homogenous	1.4	sealed	1.6	Free	Free	Free	0	0	0	0	2.61	0.03
B54	sandwich Biscuit coated chocolate	12.41	5.5	homogenous	2.3	sealed	0	Free	Free	Free	2.2	0.1	0	2.9	1.91	0.12
B55	Wafer with coconut coated milk and chocolate	28.53	1.1	homogenous	2.1	sealed	0	Free	Free	Free	0	0	0	0	1.95	0.01
B56	Wafer with chocolate	104.2	3.2	homogenous	2.01	sealed	0	Free	Free	Free	0	0	0	0	1.68	0.05
B57	Wafer with nut cream	37.63	2.7	homogenous	0	sealed	4.3	Free	Free	Free	0	0	0	0	4.19	0.07
B58	Wafer coated chocolate and milk	43.6	7.05	homogenous	0.6	sealed	0	Free	Free	Free	0	0	0	0	3.25	0.02
B59	biscuit Filled peanut	61.17	3.05	homogenous	0.9	sealed	0	Free	Free	Free	0	0	0	0	12.87	0.08
B60	biscuit Filled cream	21.14	7.8	homogenous	5.4	Sealed	3.2	Free	Free	Free	0	0	0	1.8	2.46	0.09
B61	biscuit Filled peanut and coated cocolin	49.05	5.6	homogenous	1.3	Sealed	0	Free	Free	Free	0	32	0	0	1.06	1.1
B62	Wafer with strawberry flavor	83.33	2.7	homogenous	1.1	Sealed	0	Free	Free	Free	0	0	0	0	0.41	0.07

Table (2) Shows the Physiochemical tests of the different commercial types of studied sweets cake samples during 2022

Samples	Type of sweets	color	Net weight (gm)	Moisture (%)	Texture	Broken parts (%)	package sealing	Design defect	Rancid smell	Foreign materials and burn	Insect contamination	Aspartame (ppm)	Sorbic acid (%)	Saccharin (ppm)	Acesulfam-k (ppm)	Cu (ppm)	fatty acid as oleic acid (%)	% of Ash acid insoluble
SC1	Cake Filled chocolate sauce	Suitable	23.4	15.23	homogenous	5.3	sealed	0	Free	Free	free	0	0.07	0	0	2.3	0.82	0.03
SC2	Cake Filled date	not	17.5	17.8	not	2.7	not	0	Not	Not	Not	0	1.20	0	0	11.7	5.3	1.01
SC3	Musaic cake	Suitable	45.89	17.34	homogenous	4.1	sealed	0	Free	Free	Free	2.9	0.2	0	0	0	1.30	1.03
SC4	Local cake	Suitable	37.9	15.44	not	7.1	Not	11.1	Not	Not	Free	0	1.81	0	0	0	0.43	0.08
SC5	Cacao cake	Suitable	50	16.74	homogenous	0.5	sealed	0	Free	Free	Free	0	0	3.5	0	1.3	0.68	0.02
SC6	Cacao cake coated chocolate and milk cream	Suitable	45	15.01	homogenous	1.3	sealed	0	Free	Free	Free	0	0	0	1.9	0	0.49	0.01
SC7	Cake Filled date	Suitable	14.9	14.1	homogenous	5.7	sealed	0	Free	Free	Free	0	0	0	0	1.6	2.1	0.01
SC8	cake coated white cocolin with peanut	Suitable	55.75	18.9	homogenous	0.7	sealed	0	Free	Free	Free	0	0	0	0	0	0.85	0.002
SC9	Cake with coconut	Suitable	44.85	16.4	homogenous	3.8	sealed	0	Free	Free	Free	0	1.01	0	0	7.8	0.5	0.06

Samples	Type of sweets	color	Net weight (gm)	Moisture (%)	Texture	Broken parts (%)	package sealing	Design defect	Rancid smell	Foreign materials and burn	Insect contamination	Aspartame (ppm)	Sorbic acid (%)	Saccharin (ppm)	Acesulfam-k (ppm)	Cu (ppm)	fatty acid as oleic acid (%)	% of Ash acid insoluble
SC10	Brawnie cake Filled chocolate cream	Suitable	37.7	13.4	homogenous	0.7	sealed	5.4	Free	Free	Free	0	0.61	0	0	4.3	0.1	1.3
SC11	Cinnabon cake	Suitable	44.6	13	homogenous	4.9	sealed	0	Free	Free	Free	0	0.21	0	0	2.1	0.7	0.9
SC12	cake Filled date	Suitable	14.59	12.5	not	5.5	sealed	0	Not	Free	not	0	0	20.7	0	0	1.7	2.08
SC13	cake Filled date	Suitable	52.32	13.2	homogenous	3.6	sealed	3.4	Free	Free	Free	0	0	4.7	0	4.3	3.5	0.51
SC14	cake Filled date	Suitable	15.27	16.5	homogenous	3.1	sealed	0	Free	Free	Free	0	0	0	0	17.9	2.4	1.58
SC15	Cocao cake with milk and coconut sauce	Suitable	60.97	17.35	homogenous	4.3	sealed	0	Free	Free	Free	0	2.51	0	0	5.2	0.59	0.03
SC16	Muffin cake Filled cacao cream	Suitable	26.86	15.1	homogenous	4.8	sealed	0	Free	Free	Free	0	0.21	0	0	2.1	0.46	1.3
SC17	Musaic cake	Suitable	93.92	16.91	homogenous	5.9	sealed	0	Free	Free	Free	0	0	0	0	0	0.43	0.04
SC18	Cake with cream	Suitable	48.5	18.5	homogenous	2.2	sealed	2.7	Free	Free	Free	0	0.28	0	3.6	0	0.86	0.01
SC19	Cake coated milk and coconut	Suitable	52.41	17.58	homogenous	1.2	sealed	0	Free	Free	Free	0	0	0	0	3.4	0.35	0.04
SC20	Musaic cake with milk chocolate sauce	Suitable	49	18.19	homogenous	5.7	sealed	0	Free	free	Free	0	0	0	0	0	0.77	2.11
SC21	Musaic cake Filled cacao sauce	Suitable	43	15.2	homogenous	2.6	sealed	0	Free	free	Free	0	0.30	0	0	0	0.55	0.91

b- Bacterial tests:

1- **Enterobacteriaceae:** The Enterobacteriaceae are natural habitants of a wide variety of environments including human and animal gastrointestinal tract and they are causative agents of many foodborne infections in humans (Wawire et al., 2013). The detection of unacceptable levels of Enterobacteriaceae in few of the samples analysed was of economic importance since Enterobacteriaceae are opportunistic pathogens that are responsible for majority of infections including that of the urinary tract (Livermore and Woodford, 2006). Few samples only show unacceptable levels Enterobacteriaceae, which were higher than the permissible limit (Table 8) these samples B2, B4, B17, SC2 and SC4 (Table 3, 4).

2- **Salmonella spp:** Salmonellae spp are true pathogens, which are one of the most common causes of bacterial food poisoning (HPSC, 2003). All studied samples of different brand products were free from Salmonella bacteria (Table 3, 4,).

3- **Bacillus cereus:** Bacillus cereus is present in many foods due to its ubiquitous nature and has become one of the top ten causative agent responsible for many cases of food and waterborne outbreaks in societies (EFSA, CDC, 2018). Out all the studied samples there were only six samples contains Bacillus Cereus bacteria, B4, B17, SC2, SC4 (Table 3, 4).

4- **Staphylococcus aureus:** Staphylococcus aureus is a bacterium that causes staphylococcal food poisoning in man, a form of gastroenteritis with rapid onset of symptoms (Talan et al. 1989; Khambaty et al. 1994; Le Loir et al. 2003). out all studied samples there were only six samples contains Staphylococcus aureus bacteria B2, B4, B17, SC2, SC4 (Table 3, 4).

5- **Escherichia coli 0157:H7:** E. coli O157:H7 was the first associated microorganism with human disease in the 1980s, when it was linked to haemorrhagic colitis and then to haemolytic uraemic syndrome (HUS), (Karmali et al, 1983; Riley et al, 1983). This particular serotype had not been previously linked to human disease (Besser et al, 1999) but since then E. coli O157:H7 has been increasingly implicated in sporadic cases of human diarrhoeal disease, as well as in major outbreaks in up to 30 countries including the UK, North America and Japan (Besser et al, 1999; Kaper et al, 2004). In the present study, Escherichia coli 0157 were found in three samples only B2, B17 and SC2 (Table 3 and 4).

Table (3) bacteriological evaluation of the different commercial types of studied biscuits samples during 2022

samples	Types of biscuits	Enterobacteriaceae	Salmonella spp	Bacillus Cereus	Staphylococcus aureus	Escherichia coli 0157
B1	Biscuit with Marshmallow	1×10^2	-	1×10^3	1×10^2	-
B2	Wafer with milk chocolate	8.3×10^3	-	5.4×10^4	1.7×10^4	+
B3	Plain wafer	1×10^2	-	1×10^3	1×10^2	-
B4	biscuit with chocolate cream	5.1×10^4	-	8.7×10^4	6.7×10^5	-
B5	Biscuit with coconut and cream	1×10^2	-	1×10^3	1×10^2	-
B6	Wafer with milk	1×10^2	-	1×10^3	1×10^2	-
B7	biscuit With vanilla cream	1×10^2	-	1×10^3	1×10^2	-
B8	Wafer with coconut and chocolate	1×10^2	-	1×10^3	1×10^2	-
B9	Wafer with crispy rice and chocolate	1×10^2	-	1×10^3	1×10^2	-
B10	Wafer with milk cream	1×10^2	-	1×10^3	1×10^2	-
B11	Wafer with nut cream	1×10^2	-	1×10^3	1×10^2	-
B12	Crispy Wafer with cream flavor	1×10^2	-	1×10^3	1×10^2	-
B13	sandwich Biscuit	1×10^2	-	1×10^3	1×10^2	-
B14	Plain Biscuit	1×10^2	-	1×10^3	1×10^2	-
B15	Wafer with strawberry flavor	1×10^2	-	1×10^3	1×10^2	-

samples	Types of biscuits	Enterobacteriaceae	Salmonella spp	Bacillus Cereus	Staphylococcus aureus	Escherichia coli 0157
B16	Plain Biscuit	1×10^2	-	1×10^3	1×10^2	-
B17	Filled Wafer	1×10^4	-	7.2×10^4	3.4×10^3	+
B18	Filled biscuit	1×10^2	-	1×10^3	1×10^2	-
B19	Plain biscuit	1×10^2	-	1×10^3	1×10^2	-
B20	Filled biscuit	1×10^2	-	1×10^3	1×10^2	-
B21	biscuit Filled custard flavor	1×10^2	-	1×10^3	1×10^2	-
B22	Wafer With Marshmallow	1×10^2	-	1×10^3	1×10^2	-
B23	Plain biscuit	1×10^2	-	1×10^3	1×10^2	-
B24	Wafer with chocolate	1×10^2	-	1×10^3	1×10^2	-
B25	Wafer Filled chocolate	1×10^2	-	1×10^3	1×10^2	-
B26	Wafer Filled chocolate	1×10^2	-	1×10^3	1×10^2	-
B27	Plain Biscuit	1×10^2	-	1×10^3	1×10^2	-
B28	Wafer with chocolate	1×10^2	-	1×10^3	1×10^2	-
B29	Wafer Filled dates	1×10^2	-	1×10^3	1×10^2	-
B30	Wafer Filled chocolate and nut	1×10^2	-	1×10^3	1×10^2	-
B31	Plain Wafer	1×10^2	-	1×10^3	1×10^2	-
B32	biscuit Filled chocolate cream	1×10^2	-	1×10^3	1×10^2	-
B33	biscuit Filled chocolate cream	1×10^2	-	1×10^3	1×10^2	-
B34	Filled Wafer	1×10^2	-	1×10^3	1×10^2	-
B35	Filled Wafer	1×10^2	-	1×10^3	1×10^2	-
B36	crispy wafer with caramel	1×10^2	-	1×10^3	1×10^2	-
B37	Biscuit with strawberry cream	1×10^2	-	1×10^3	1×10^2	-
B38	Biscuit with dates	1×10^2	-	1×10^3	1×10^2	-
B39	Biscuit with caramel and milk	1×10^2	-	1×10^3	1×10^2	-
B40	biscuit with orange flavor	1×10^2	-	1×10^3	1×10^2	-
B41	Sandwich biscuit with Marshmallow and coconut	1×10^2	-	1×10^3	1×10^2	-
B42	Sandwich biscuit with cream	1×10^2	-	1×10^3	1×10^2	-
B43	Chocolate biscuit Filled cream	1×10^2	-	1×10^3	1×10^2	-
B44	biscuit with Marshmallow coated banana cocolin	1×10^2	-	1×10^3	1×10^2	-
B45	biscuit with chocolate	1×10^2	-	1×10^3	1×10^2	-
B46	biscuit with coconut	1×10^2	-	1×10^3	1×10^2	-
B47	biscuit with chocolate and vanilla flavor	1×10^2	-	1×10^3	1×10^2	-
B48	Plain biscuit	1×10^2	-	1×10^3	1×10^2	-
B49	biscuit Filled flavor	1×10^2	-	1×10^3	1×10^2	-
B50	biscuit with orange flavor	1×10^2	-	1×10^3	1×10^2	-
B51	biscuit Filled chocolate	1×10^2	-	1×10^3	1×10^2	-
B52	Crispy Wafer with chocolate flavor	1×10^2	-	1×10^3	1×10^2	-
B53	Wheat quaker with chocolate and nut	1×10^2	-	1×10^3	1×10^2	-
B54	sandwich Biscuit coated chocolate	1×10^2	-	1×10^3	1×10^2	-

samples	Types of biscuits	Enterobacteriaceae	Salmonella spp	Bacillus Cereus	Staphylococcus aureus	Escherichia coli 0157
B55	Wafer with coconut coated milk and chocolate	1×10^2	-	1×10^3	1×10^2	-
B56	Wafer with chocolate	1×10^2	-	1×10^3	1×10^2	-
B57	Wafer with nut cream	1×10^2	-	1×10^3	1×10^2	-
B58	Wafer coated chocolate and milk	1×10^2	-	1×10^3	1×10^2	-
B59	biscuit Filled peanut	1×10^2	-	1×10^3	1×10^2	-
B60	biscuit Filled cream	1×10^2	-	1×10^3	1×10^2	-
B61	biscuit Filled peanut and coated cocolin	1×10^2	-	1×10^3	1×10^2	-
B62	Wafer with strawberry flavor	1×10^2	-	1×10^3	1×10^2	-
units		MPN/g	--	CFU /g	CFU/g	-----

Table (4) Bacteriological evaluation of the different commercial types of studied sweets cake samples during 2022

samples	Types of biscuits	Enterobacteriaceae	Salmonella spp	Bacillus Cereus	Staphylococcus aureus	Escherichia coli 0157
SC1	Cake Filled chocolate sauce	1×10^2	-	1×10^3	1×10^2	-
SC2	Cake Filled date	4.1×10^3	-	3.5×10^4	3.9×10^4	+
SC3	Musaic cake	1×10^2	-	1×10^3	1×10^2	-
SC4	Local cake	2.3×10^4	-	4.2×10^4	7.2×10^3	-
SC5	Cacao cake	1×10^2	-	1×10^3	1×10^2	-
SC6	Cacao cake coated chocolate and milk cream	1×10^2	-	1×10^3	1×10^2	-
SC7	Cake Filled date	1×10^2	-	1×10^3	1×10^2	-
SC8	cake coated white cocolin with peanut	1×10^2	-	1×10^3	1×10^2	-
SC9	Cake with coconut	1×10^2	-	1×10^3	1×10^2	-
SC10	Brawnie cake Filled chocolate cream	1×10^2	-	1×10^3	1×10^2	-
SC11	Cinnabon cake	1×10^2	-	1×10^3	1×10^2	-
SC12	cake Filled date	1×10^2	-	1×10^3	1×10^2	-
SC13	cake Filled date	1×10^2	-	1×10^3	1×10^2	-
SC14	cake Filled date	1×10^2	-	1×10^3	1×10^2	-
SC15	Cocao cake with milk and coconut sauce	1×10^2	-	1×10^3	1×10^2	-
SC16	Muffin cake Filled cacao cream	1×10^2	-	1×10^3	1×10^2	-
SC17	Musaic cake	1×10^2	-	1×10^3	1×10^2	-
SC18	Cake with cream	1×10^2	-	1×10^3	1×10^2	-
SC19	Cake coated milk and coconut	1×10^2	-	1×10^3	1×10^2	-
SC20	Musaic cake with milk chocolate sauce	1×10^2	-	1×10^3	1×10^2	-
SC21	Musaic cake Filled cacao sauce	1×10^2	-	1×10^3	1×10^2	-
units		MPN/g	--	CFU /g	CFU/g	-----

Table (5) Yemen Standardization and Metrology Organization (YSMO*) of Physiochemical tests of biscuits and cake.

Tests	Dried Plain biscuit	Plain soft biscuit	Filled biscuit	Filled biscuit or coated Filled	Filled wafer and coated	Plain wafer	Local cake	Filled and coated cake
Moisture (%)	5	7	5	2	10	5	20-27	15-25
Texture	Homogenous	Homogenous	Homogenous	Homogenous	Homogenous	Homogenous	Homogenous	Homogenous
Broken parts (%)	5	5	5	2	5	5	5	5
package sealing	Sealed	Sealed	Sealed	Sealed	Sealed	Sealed	Sealed	Sealed
Design defect %	10	10	10	10	10	10	10	10
Rancid smell	Free	Free	free	free	free	free	free	free
Foreign materials and burn	Free	Free	Free	Free	Free	Free	Free	Free
Insect contamination	Free	Free	Free	Free	Free	Free	Free	Free
Aspartame (ppm)	Free	Free	Free	Free	Free	Free	Free	Free
Sorbic acid (%)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Saccharin (ppm)	Free	Free	Free	Free	Free	Free	Free	Free
Acesulfam-k (ppm)	Free	Free	Free	Free	Free	Free	Free	Free
Cu (ppm)	3	3	10	10	10	3	10	10
Ash acid insoluble (%)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
fatty acid as oleic acid (%)	1	1	1	1	1	1	1	1
Color	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable
Stick with the cover	Not	Not	Not	Not	Not	Not	Not	Not

*= YSMO GSO (989 :2012, 104 :2006,1320 :2012, 263 /2012, 567 /2012, 995 /2012).

Table (6) Yemen Standardization and Metrology Organization (YSMO*) of Bacterial tests of biscuits and cake

Test	Dried Plain biscuit	Plain soft biscuit	Filled biscuit	Filled biscuit or coated Filled	Filled wafer and coated	Plain wafer	Local cake	Filled and coated cake
Enterobacteriaceae	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2
Salmonella spp	-	-	-	-	-	-	-	-
Bacillus Cereus	1×10^3	1×10^3	1×10^3	1×10^3	1×10^3	1×10^3	1×10^3	1×10^3
Staphylococcus aureus	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2	1×10^2
Escherichia. coli 0157	-	-	-	-	-	-	-	-

*= YSMO GSO1016:2019.

Conclusion

The results indicate that, there were some cake and biscuits products of different brands incompatible with YSOM so it needs to modify to be suitable for consumers consumption.

Not all the samples studied shows physic- chemical properties similar to YSOM. In case of bacterial analysis there were some samples show no validity for consumption because of its bacterial contamination. Therefore, these type of products required general government system censorship programm for checking them permanently to insure that it meet YSOM food safety criteria for consumption. Furthermore, the governmental respective branch offices of food safety programm must order the manufacturer to represent all the respective food product criteria on theses product labels and there must be stern warning to those violating companies.

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