UTILIZATION OF LOCALLY PRODUCED DESICCATED COCONUT IN PLAIN AND MILK CHOCOLATE

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ABSTRACT

Value addition to locally produced coconuts is an alternative livelihoods support to coconut famers and generates new markets for Ghana's coconuts. Fresh matured un-bruised de-husked West African Tall coconuts were grated, hot-water blanched for sixty seconds and oven-dried (80°C-90°C) for ten hours. The samples were then milled and conditioned in a refrigerator for seven days. Coconut centers were made out of the samples and dipped into milk and dark chocolate masses for coating. A 7 point hedonic scale sensory evaluation analysis was carried out with 33 untrained panelists. ANOVA results on the sensory data showed higher preference for the desiccated milk chocolate (DCMC), ($P<0.05$). Proximate values for desiccated plain chocolate (DCPC) and DCMC respectively were: fibre ($2.40 \pm 0.00\%$ and $3.10 \pm 0.00\%$), protein ($6.40 \pm 0.00\%$ and $9.50 \pm 0.00\%$), fat ($39.35 \pm 0.73\%$ and $42.88 \pm 2.34\%$), ash ($1.37 \pm 0.12\%$ and $2.04 \pm 0.76\%$), moisture ($2.96 \pm 0.08\%$ and $3.61 \pm 0.25\%$) and sugar ($26.94 \pm 0.02\%$ $25.93 \pm 0.15\%$). Microbiological values for the DCPC and DCMC respectively were: Total Viable Counts (50 and 260 CFU/ml), Mould/Yeast (0 and 720 CFU/ml), Coliforms (0 CFU/ml) perhaps due to contamination. The study proved that coconut can be incorporated into locally manufactured chocolates, especially milk chocolates.

Keywords: Desiccated coconut; chocolate liquor/masse; conched; tempered

INTRODUCTION

Coconut (*Cocos nucifera L.*) is a lavish gift from nature which has over the years provided three basic needs of man; food, fibre and shelter (Salunkhe and Desai, 1998). The description of the nut dates back to 545 AD during which time it was called the 'Green Nut of India'. Coconut is a perennial tropical monocot crop belonging to the Areacaeae family. Some varieties of this family are Tall, *Nucifera var. 'typica'*, and Dwarf, *Nucifera* var. *'nana'*. The real origin of the nut after series of debate has been agreed to be the South-East Asia (Gomes and Prado, 2008).

Coconut is grows throughout the humid zones which falls between approximately 5°N and 25°S. Its widespread distribution has been attributed to the water dispersal and the multiple purposes uses (Ohler, 1999). Coconuts can grow both on the coastal land as well as areas in the hinterlands (de Taffin, 1998). It flowers and fruits all year in the tropics. The Dwarf varieties are less hardy (more susceptible to diseases and adverse effect of draught) hence grown on small scale. The Tall varieties on the other hand are hardy, adapted to varying soil types, climate and draught regimes, hence grown commercially. Tall coconuts can stay up to 40-90 years (Duke, 1983). Indonesia as at 2006 was the leading producer which was followed by the Philippines and India (NIIR Board of Consultants and Engineers, 2006).

Coconut is reported to have a lot of nutritional and medicinally important properties, including; anti-helmintic, antiseptic, aphrodisiac, purgative, a diuretic etc. It is also believed to help in remedying tumors, abscess, alopecia, constipation, cough, dysentery, ear ache, burns, colds, gingivitis, scabies, sore throat, stomach swelling, syphilis, toothache and typhoid etc (Duke, 1983).

The crop plays an important role in the socio-economic and cultural lives of 26% of the world's population, in about 16 counties, primarily the Asia Pacific regions (NIIR Board of Consultants and Engineers, 2006). In Ghana, 8% of the population depends on coconut as livelihood support. The bulk of country's coconuts come from the Western Region. Studies carried out by Osei-Bonsu et al.(2005) in Ellembele, and Afariba (2006) of the Western Region, however showed that coconut famers in these as still not making enough to take care of themselves and their family due to challenges such as inadequate skills, machinery, competitive market, unfavourable tax regime and post-harvest losses etc. Evidence has shown that a friendly tax system and pricing policy is important in helping farmers make use of new technologies in their farming activities, which will translate into profits (International Institute of Tropical Agriculture, 1993).

Coconut provides many of economic benefits including production of activated carbon (from coconut shell), ropes (from coconut fibre), milk, coconut meal, oil, coconut cake and desiccated coconut (DC), (de Taffin, 1998). More than hundred countries import desiccated coconut, the Philippines, Sri Lanka and Indonesia are leaders in global importer of DC (NIIR Board of Consultants and Engineers, 2006). Desiccated coconut is a crisp, snow white sweet tasting and pleasant smelling nut, which has a maximum moisture value of 3.0% H_2O/g of dried product (NIIR Board of Consultants and Engineers, 2006). Desiccated coconut is currently on high demand, because of its multiple uses in confectionary products and allied foods, as well as its export potential (de Taffin, 1998). Ohler in 1999 also reported on its uses in chocolates as well as candies. There have been attempts also to process coconut into alcohol (de Taffin 1998). Annoh- Quashie (2007) made a coconut water-based energy drink, which was nutritious and of good sensory appeal.

Local consumption of coconut has limited the knowledge for industrial processing of the nut into products such as confections (Fosu, 2006). Companies like Sweet Kiss and Mars International on the other hand are making use of coconut in their confectionery products. Such success stories are the thrust of this study which sought to optimize the incorporation of desiccated coconut into locally made chocolates. The specific objective was to develop a desiccated coconut milk as well as dark chocolate and test how it impacts on proximate, microbiological and sensory properties of the chocolates.

MATERIALS AND METHODS

Twelve fresh mature and unblemished West Africa Tall coconut varieties, averaging 500g each, were obtained from the Agbogbloshie market in Accra for the study, whiles conched and tempered fresh Milk and Dark Chocolate masses (liquor) were obtained from Cocoa Processing Company Limited (CPC) Tema.

Sample Preparation

Developing Desiccated Coconut - Centres De-husked coconuts were cleaned in hot brine water before cracking to obtain the fruit pulp. The brown cortex was then removed by pairing. Pared coconuts were hot water blanched (1min) to inactivate spoilage enzymes (Gunberg, 2008) and dried in an air-oven at 50-60°C for 10 hrs. The dried coconuts were kept in fridge storage for 1-4 weeks before milling.

Developing Chocolate Coated DC Centres: Portions of the desiccated coconut were mixed with glycerol, glucose syrup and glycerin to make centres. These were dipped separately into milk chocolate and dark chocolate masses. The samples were then dried in a freezer followed by room temperature air-drying. They were then wrapped for storage in a fridge.

Proximate Analysis - Duplicates of randomly sampled parts of the Milk and Dark Chocolates were analysed for proximate values of fat, sugar, moisture, ash, crude fibre, and protein. The simple means of the replicates data were analyzed using standard deviation.

Percentage Fat Determination: Soxhlet extraction method was used for 20g replicate samples, done at a temperature of 40-60°C for 5hrs. The percentage fat was calculated as;

$$\% \text{ Fat} = \frac{\text{weight of fat in sample after extraction}}{\text{Weight of original sample taken before extraction}} \times 100\%$$

Percentage Sugar determination: The polarimetric method was used for 40g replicate samples. Samples dissolve in 100ml distilled water (50-600), were clarified with 24ml lead solution, which was made up to 200ml with distilled water and filtered. The presence of excess lead was checked with 10% potassium iodide solution, and corrected using oxalate solution. Distilled water was used as blank solution.

Percentage Moisture determination: The air-oven method was used for 20g replicate samples. Sample were dehydrated at 105-106°C for 5hrs. The loss in weight after dehydration was calculated as a ratio of the original sample before dehydration:

$$\% \text{ Moisture} = \frac{\text{Loss in weight of sample after drying}}{\text{Initial weight of sample}} \times 100\%$$

Percentage Ash determination: Dry ashing was done using the Muffle furnace method for 20g replicate samples (AOAC 923.03, 2000) 17th Edition. Ashing was done at 500-600°C for 30min. The weight of the ash was expressed as a ratio to the initial weight of samples:

$$\text{Percentage } \% \text{ Ash} = \frac{\text{weight of ash}}{\text{Initial weight of sample}} \times 100\%$$

Percentage crude fibre: Replicates samples (2g each) were analysed for moisture using methods stated in Pearson's Composition and Analysis of Foods(1997) 9th Edition.

Percentage Crude protein: Replicate de-fatted samples (0.3g each) were analysed for protein content using AOAC 984.13 (1990) 15th Edition.

Microbiological Analysis

Replicate samples (10g each) were weighed into 90ml sterile Ringer solution and homogenized and stored at 37°C for inoculation and autoclaving. Mean counts were analyzed using standard deviation, and the results compared with Cocoa Processing Company chocolates and coconut standards stated by Ohler (1999).

Total Plate Counts (TPC): Pour plating of serially diluted samples was done using agar, which were incubated at 37°C for 48hrs. Microbial colonies were counted using the colony counter.

Yeast and Moulds - Pour plating with acidified malt extract was carried out for 1ml portions of samples. Incubation was done at 25°C for 120hours, and microbial colonies countered using a colony counter.

Coliform - Portions of test samples (1ml) were pipette into duplicate test tubes containing 9ml sterile Lauryl Tryptose Broth which had inverted Durham tubes used to trap escaping gases. Incubation was done at 37°C for 24hrs.

Sensory Evaluation

A 7- point hedonic method with 33 randomly selected untrained panelists made up of workers and students of the University of Cape Coast in the Central Region of Ghana was used to evaluate the sensory attributes of the developed products. Panelist were served with randomly coded samples of the Desiccated Coconut Milk Chocolate (DMC) and Desiccated Coconut Dark Chocolate (DCPC) to indicate their preference, by scoring for the attributes colour, taste, texture, sweetness, aroma, aftertaste and overall acceptability. Control samples used were 'Bounty Milk and 'Bounty Dark Chocolate'. The results were displayed as bar charts. Analysis of variance at 95% significance was carried out on the mean scores.

RESULTS AND DISCUSSION

Desiccated Coconut Milk and Dark Chocolates

The desiccated coconut was snow white in appearance and had the flavor of coconut, which increased when it was blended. There was difficulty mixing freshly desiccated coconut with the binders, it however became easier upon conditioning in the refrigerator for four weeks. The centres were formed by releasing some about of coconut oil form the milled desiccated coconut. The final product had about 25% chocolate coating on coconut centre which was 75%, as can be seen in Table 1 of Appendix. Figure 1 shows the proximate values for Desiccated Coconut Plain Chocolate (DCPC) and Desiccated Coconut Milk Chocolate (DCMC).

Proximate Analysis

Figure 1 shows the results for the proximate analysis carried out on the DCPC and DCMC.

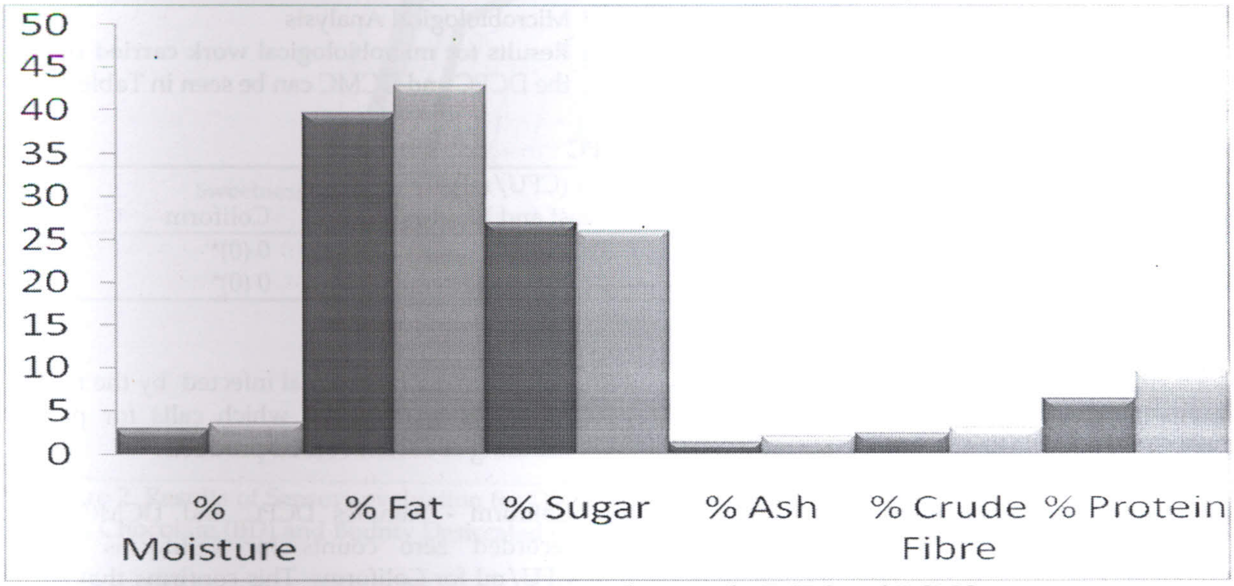

Figure 1. The results for the proximate analysis carried out on the DCPC and DCMC.

Moisture - The moisture content of DCPC (2.96+0.08%) was lower than DCMC (3.61+0.25%). The difference is believed to be due to the non-uniform proportions of the DC centres, since they were handmade. The values of both chocolate samples exceeded CPC values of Dark chocolates (0.21%), Milk chocolates (1.36%) and Milk and Nut chocolates (1.34%).

Fat - Samples DCPC had a lower fat content of 39.35+0.73% compared with DCMC (42.88±2.34%). Both samples had fat values higher than standard values for CPC Milk Dark Chocolate (28.50%), Milk chocolates (32.16%) and Milk and Nut chocolates (32.18%) respectively. This trend was anticipated because the Milk chocolate masse from which the DCMC originally is high in fat compared with the Dark chocolates masse.

Sugar - The DCPC had higher sugar content (26.94+0.02) compared with DCMC (25.93+0.15%). Both samples were lower than standard CPC Dark chocolate (48.60%), Milk chocolate (36.03%) and Milk and Nut chocolate (36.45%) respectively. This was expected because the Dark Chocolates are higher in sugar. The addition of the coconut solids could have further reduced the sugar levels of the chocolates for both DCPC and DCMC.

Ash - The DCPC had lower percentage ash (1.37+0.12%) compared with the DCMC (2.04±0.76%). The DCPC had lower ash values compared with CPC Dark chocolate (1.50%), CPC Milk chocolate (1.99%) and CPC Milk and Nut chocolate (1.89%) respectively. The DCMC on the hand was higher in ash content compared with CPC Dark chocolate (1.50%), CPC Milk chocolate (1.99%) and CPC Milk and Nut chocolate (1.89%) respectively. This was anticipated because the Milk chocolates have more milk solids, which are high minerals as compared with plain cocoa.

Crude Fibre - The DCPC was lower in crude fibre (2.40±0.00%) and compared with DCMC (3.10 ± 0.00%). These values were both higher than those stated in the Pearson's Composition and Analysis of Foods(1997) 9th Edition

Pearson's bòok, which had fibre content for Dark chocolate as 0.4-0.7% and Milk chocolate (0.2-00.5).

Crude Protein - The DCPC had lower crude protein value (6.40+0.00%) compared with DCMC (9.50+0.00%). The value for DCPC although higher than crude fibre values for CPC Dark chocolates (0.63%), it was lower than the CPC Milk and Nut chocolate (11.31%) obviously the peanut in the CPC chocolate were more protein rich than DC. The DCMC had higher crude protein value compared with CPC Milk chocolate (9.22%), it was however lower when compared with the CPC Milk and Nut chocolate (11.31%).

Microbiological Analysis

Results for microbiological work carried out on the DCPC and DCMC can be seen in Table 1.

Table 1: Microbiological results for the DCMC and DCPC

	Microbial Load (CFU/ml)		
Sample Code	Total Plate Count (TPC)	Yeast and Mould Count	Coliform
DCPC	50 (30-300)*	720 (50)*	0 (0)*
DCMC	260 (30-300)*	0 (0)*	0 (0)*

*Counts in parenthesis represent standard values used by CPC.

Total Plate Count - The DCPC were lower counts (50 CFU/ml) compared with the DCMC (260 CFU/ml). Although both samples were within the (30-300 CFU/ml) for CPC chocolates as shown in appendix II, the DCMC was above CODEX accepted levels (10^2 CFU/ml), referring to appendix III.

Yeast and Mould - There were no recorded counts for DCMC (0 CFU/ml). Sample DCPC however recorded counts above CPC standard levels (0-50 CFU/ml) as well as CODEX levels for cocoa (10^2). There was a worry concerning DCPC because studies by Conrado and Carl (1981) revealed presence of carcinogenic Alflatoxin in copra meal infected by the mould *Aspergilus* sp.microbes, which calls for proper handling of coconut based products.

Coliform - Samples DCPC and DCMC both recorded zero counts for Coliforms i.e. 0 CFU/ml for Coliforms. This confirms that there handling was well done.

Sensory Evaluation

Figure 2 shows the results of Sensory evaluation carried out for DCPC and DCMC compared with Bounty Desiccated Coconut Dark Chocolate (BD) and Bounty Desiccated Coconut Milk Chocolate (BM).

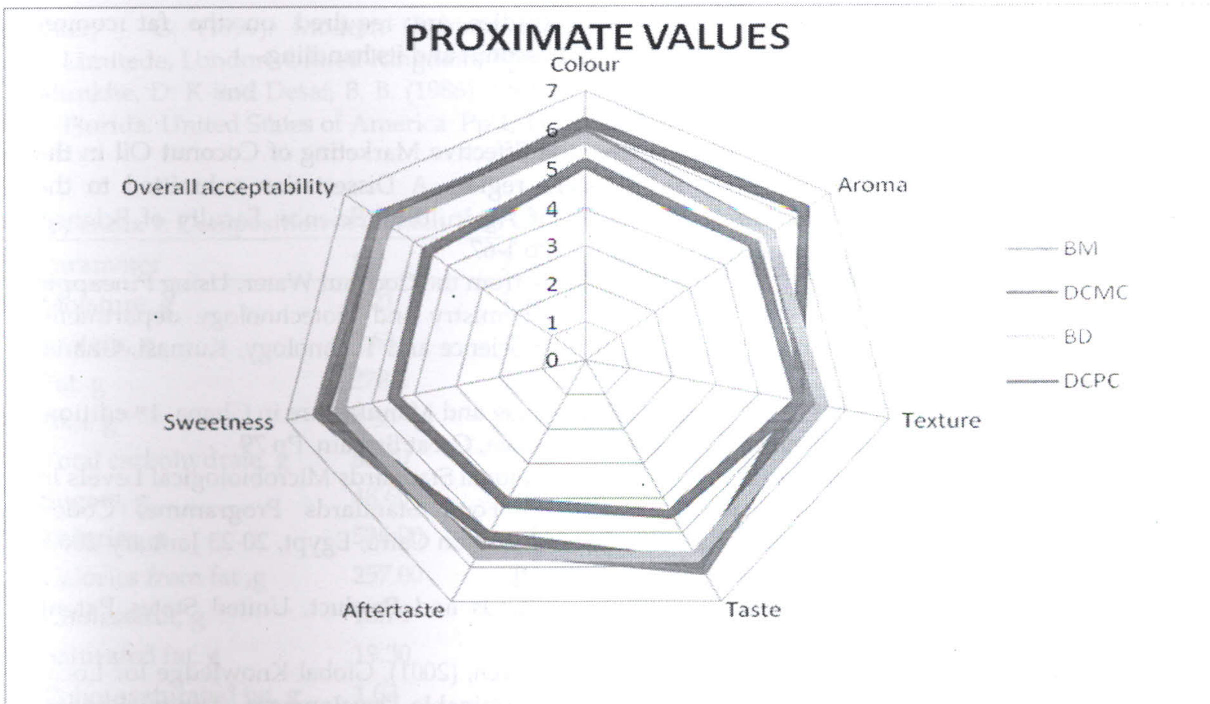

Figure 2. Results of Sensory evaluation for DCPC and DCMC compared with Bounty Desiccated Coconut Dark Chocolate (BD) and Bounty Desiccated Coconut Milk Chocolate (BM).

Colour - Mean scores for preference of the samples were; DCMC (6.18) >BM (5.91) >BD (5.76) > DCPC (5.12) respectively. There was significant difference among all treatments ($p<0.05$).

Aroma - Mean scores for preference of the samples were; DCMC (6.3) >BM (5.3) >BD (5.3) >DCPC (4.83). There was significance difference among all treatments ($p<0.05$)

Texture - The mean scores for samples were; BD (5.48) >BM (5.18) >DCPC (4.94) >DCMC (4.91). There was no significant difference between treatments ($p>0.05$)

Taste - Mean scores for preference of the samples were; BM (6.09)>DCMC (5.94)>BD (5.73)>DCPC (4.48). There were significant difference between the treatments ($p<0.05$).

Aftertaste - Mean scores for preference of samples were; BD (5.67) >BM (5.48) >DCMC (5.09) >DCPC (4.15). There were significant difference between the treatments ($p<0.05$)

Sweetness - Mean scores for preference of the samples were; BM (6.24) >DCMC (6.12) >BD (5.76) >DCPC (4.48). There were significant difference between the treatments ($p<0.05$)

Overall acceptability - Mean score for preference of samples were; BM (6.06) >BD (5.82) >DCMC (5.76) >DCPC (4.57). There was significant difference between the treatments ($p<0.05$).

From the above observation, it can be concluded that people have better liking for the reference sample Bounty Milk Chocolate (BM). This was expected because a lot of work was done to get a very good product as compared with the experimental samples which had very little work going into it.

CONCLUSION AND RECOMMENDATION

From the study, it was established that incorporation of desiccated coconut into locally manufactured chocolates is feasible, and can improve upon some nutritional and sensory values such as fibre in the chocolates. The method of blanching was also a success as the final product was stable from lipid oxidation. More attention must be given to the incorporation of desiccated milk chocolates as compared with the dark chocolates. Further studies are required on the fat content of coconut and its handling.

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Appendix 1: Composition of Golden Tree Chocolate of CPC (per 100g)

Parameter	1	2	3	4	RDI
Moisture, g	0.21	1.35	1.36	1.35	-
protein, g	0.63	11.31	9.22	11.31	50.00
Fat, g	278.5	32.18	32.16	32.18	65.00
Ash, g	1.50	1.89	1.99	1.89	-
Total carbohydrate, g	63.30	53.27	55.27	53.27	3000.00
Sugars, g	48.60	48.60	36.03	36.45	-
Calories, g	536.00	548.00	547.00	548.00	-
Calories from fat ,g	257.00	290.00	289.00	290.00	-
Cholesterol, g	18.70	18.70	18.70	16.50	300.00
Saturated fat, g	19.30	20.70	20.70	18.50	20.00
Polyunsaturated fat, g	1.03	1.08	1.08	2.67	-
Monounsaturatedfat,g	8.20	8.76	8.76	9.44	-
Vitamin A (Retinol),g	1220.00	1220	1220.00	1220.00	5000.00
Sodium, mg	84.00	84.00	84.00	67.00	2400.00
Potassium, mg	500.00	5000.00	5000.00	497.00	3500.00
Calcium, mg	146.00	164.00	164.00	129.00	1000.00
Iron, mg	1.65	1.65	1.65	1.65	18.00

(Awua,2002)

1. Dark Chocolate (Tetteh Quashie) 2. Dark Milk Chocolate (Portem pride) 3. Milk Chocolate Kingsbite),4. Milk and Nut Chocolate (Portem Nut).

Appendix 2. Microbiological Standards For Cpc Chocolates

Item	Microorganism	CFU/ml
Chocolate; Dark(Plain) and Milk	Total Aerobic Count	30-300
	Yeast and Moulds	0-50
	Coliform	0

Appendix 3. Microbiological Criteria for Food and Food Ingredients: Chocolates and candy products

Item	Microorganism	Limit Per Ml Or Gram			
		n	c	m	M
Chocolate: plain, butter, liquor, sweet coating, milk, milk coating, nuts, discs, butter crunch or toffee	Salmonella	10	0	0	-
	Staphylococcus aureus	5	0	0	-
	Escherichia coli	5	0	0	-
Dehydrated or frozen dessert, (bonbons, caramels and other similar products)	Aerobic plate count	5	2	10^4	10^5
	Staphylococcus	5	2	10	10^2
	Salmonella	5	0	0	-
	Escherichia coli	5	0	0	-
Cocoa	Aerobic plate count	5	2	10^2	10^4
	Yeast and Moulds	5	2	10^2	10^4
	Salmonella	10	0	0	-
	Escherichia coli	5	0	0	-
Coconut, desiccated apricot	Coliforms	5	2	10^2	10^3
	Moulds	5	2	10	10^2
	Salmonella	10	0	0	-
	Escherichia coli	5	0	0	-

(CODEX, 2003)

n: The number of sample units to be examined from a lot of chocolate and candy products; c: The maximum allowable number of marginally acceptable sample units; m: Expressed in CFU/g its represents an acceptable level and values above it are marginally acceptable or unacceptable in terms of the sampling plan; M: Expressed in CFU/g unless otherwise stated, it is a microbiological criterion which separates marginally acceptable quality from defective quality.