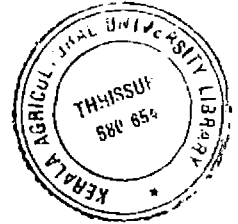


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STANDARDISATION AND ACCEPTABILITY OF DAIRY PRODUCTS WITH COCOA MASS



**By
SUNITA NAIR**

THESIS

**Submitted in partial fulfilment of the
requirement for the degree of**

Master of Science in Home Science

(FOOD SCIENCE & NUTRITION)

**Faculty of Agriculture
Kerala Agricultural University**

**Department of Home Science
COLLEGE OF HORTICULTURE
VELLANIKKARA, THRISSUR - 680 656
KERALA, INDIA**

2002

DECLARATION

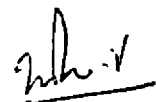
I hereby declare that the thesis entitled “**Standardisation and acceptability of dairy products with cocoa mass**” is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

Vellanikkara
1/6/2002


SUNITA NAIR

CERTIFICATE

Certified that the thesis, entitled "Standardisation and acceptability of dairy products with cocoa mass" is a record of research work done independently by Ms. Sunita Nair, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.




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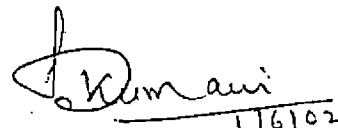
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My heartfelt thanks to all my seniors and juniors for their suggestions.

To Umaiva Chechi, lab attender, for whom this thesis was as much hers as it was mine, my thanks.

In Mr. Joy, I found somebody who could successfully unravel my spidery handwriting. Out of the confusion of hastily scribbled text, misaligned charts and skewed bar graphs, he could print out this thesis in its final form. To him and his family, my appreciation.

My husband, Anil, as always, lent a patient ear to all my woes. All love, encouragement and consolation that I sought from him, he gave me in good measure. To him, I am indebted.

To my brothers Arun and Sridhar who participated in this venture with their suggestions, constructive criticism and immense help, I am obliged.

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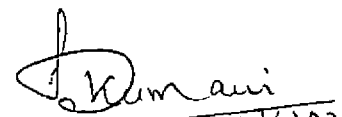
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I am delighted beyond measure as I pen the last lines. What had started as a few jittery jottings is now a thesis, complete in all respects. What had once seemed insurmountable has been triumphed over. To call it a personal accomplishment would be blasphemous, for when I flip through the pages of the manuscript I am overwhelmed by the truth that what lay in my hands is the child of the unstinted support and encouragement of my friends, family, colleagues and teachers.

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SUNITA NAIR



DEDICATED

TO MY LOVING

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Introduction

INTRODUCTION

Cocoa is the powdered product from roasted seeds from cocoa tree and is used as a raw material for chocolate and other things (Catesberg and Dommelen, 1990). The fruit of the cacao tree, known in scientific circle as 'Theobroma' literally meaning 'Food of the Gods' (Barrie, 2000).

Chocolate made from cocoa is a highly nutritive and widely appreciated confectionery. It is rich in carbohydrates, proteins and minerals. Cocoa contains a little caffeine and a related chemical, theobromine which stimulate the nervous system. It is easily digestible and holds useful units of vitamin E, phosphorus, calcium and iron.

In India commercial cultivation of cocoa was started in early 1960's but expansion in area gained momentum only from 1970 onwards. India produces about 5700 tonnes of cocoa beans from an area of 10600 ha and earns about Rs.34 million as foreign exchange. The area under cocoa during 1983-84 was 22,230 ha and it has come down to 10,600 ha during 1995-96, whereas the production was fluctuating between 56,100 to 77,100 kg.

The negative trend in area under cocoa cultivation is mainly due to lack of interest of the farmer because of severe price fluctuation and unremunerative price. The growers are forced to sell the produce to multinational companies as the technology for utilization of cocoa at household level is not standardised. The marketing of cocoa is controlled by a handful of big companies who prefers to import cocoa rather than supporting the Indian growers. A solution to this problem

is to increase the utilization of cocoa as cocoa mass. The extraction of cocoa butter is very difficult at house hold level, there is a need to develop most acceptable products incorporating cocoa mass which can be used for popularization and thereby increasing the utilization of cocoa.

Hence the present study was undertaken to standardize dairy products incorporated with cocoa mass and to evaluate the acceptability.

Review of Literature

2. REVIEW OF LITERATURE

2.1 Cultivation of cocoa

Cocoa (*Theobroma cacao*) is a perennial tropical beverage crop grown around the equator from sea level to an altitude of 900 meters under well distributed rainfall and temperature range of 15°C to 40°C (Wickramasinghe and Jacob, 1983; John, 2000). Cocoa originated in Amazon basin of South and Central America (Rao, 2000).

Presently cocoa is cultivated both as plantations as well as on small holdings (Wood and Lass, 1985). The first evidence of the cultivation of cocoa in Mesoamerica dates back to two thousand years. The Maya Indians were the first to cultivate this tree (Mossu, 1992); and was first introduced into Africa during 1822 (Aguilar, 1997). Cocoa cultivars grown in Venezuela are greatly appreciated internationally having excellent flavour and aroma (Liendo *et al.*, 1997). The West African beans were of a high quality and ideal for chocolate production (Petithugwen, 1998).

According to Lewis (1998) *Theobroma cocoa* is indigenous to South America. Indonesian cocoa growers in Sulawesi and Sumatra currently benefits from more favourable natural conditions than their counterparts in Cote d' Ivoire and Ghana, thus there was a marked increase in cocoa production in Sulawesi (Yoddang, 1999). Cultivation in Venezuela is apparently not carried out on advanced lines (Wright, 1999). He pointed out that considerable attention is paid to the cultivation of cocoa in parts of Gautemala where conditions are favourable for

this crop on account of the volcanic soil being very fertile and the sufficient water supply. According to Nair (2000) the major cocoa producing countries are Ivory Coast, Ghana, Indonesia, Brazil and Nigeria, their total contribution comes to 82 per cent.

Cocoa was introduced into India as early as in 1793, but it remained as a museum specimen in botanical gardens, orchards and house compounds (Nair, 2000). Attempts to cultivate the crop in India were made only during 1960's (Mallika *et al.*, 2000). In India cocoa was first introduced in Kerala in the early sixties from Ghana (Rao, 2000). Kerala accounts for about 80 per cent of area under cultivation (Abraham *et al.*, 2000). Cocoa grows and produces well in the plains of Kerala. (Nair *et al.*, 2000). Massive area coverage did take place through distribution of cocoa seedlings (Balasubramanian, 2000). States like Kerala, Karnataka, Goa and some parts of Maharashtra, Pondicherry, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal will therefore offer considerable scope for its development as these areas are coastal belts (Nair *et al.*, 2000). In Kerala Agricultural University, thousands of budded plants of improved clones are being produced and distributed to the growers (Mallika, 2000).

According to Sikka *et al.* (1983) Kerala is the largest cocoa producing state in India. Cocoa bean production has great potential for increase. It is estimated that 50 per cent of the current crop is lost through pests and diseases. If this damages were controlled, production would instantly increase and growing cocoa would become much more profitable, giving an incentive to more farmers to

take up cultivation (Krishnaswamy, 1995). The area under cocoa cultivation in India during 1983-84 was 22,230 ha and it has come down to 11,080 ha during 1993-94. The negative trend in the area under cocoa cultivation was mainly due to the lack of interest among the farmers because of the severe price fluctuation and non-remunerative price. The marketing of cocoa is controlled by a handful of big companies like Cadburys, Nestle, Amul etc. and they imported cocoa at lower rates (George, 1997).

2.2 Importance of cocoa

Cocoa powder and chocolate contains a proportion of carbohydrates, fats and protein together with some vitamins and vitamin B complex. Consumption of cocoa preserves health, sickness diverted and cured, especially the diseases of the guts and fluxes and coughs of the lungs (Wood, 1975). Its theobromine and caffeine content in cocoa produce a mildly stimulating effect. The carbohydrate and easily digested fat in chocolate make it an excellent high energy food (Cook, 1978). A cup of cocoa has a higher nutritive value than a cup of coffee or tea (Swaminathan, 1979). Both cocoa powder and chocolate have a high calorific value. Cocoa makes a very nutritious drink when mixed with milk and sugar and the presence of 2 per cent theobromine gives a mildly stimulating action. The inclusion of milk protein in milk chocolate provides proteins of high biological value (Anon, 1979). Chocolate and cocoa products though have a food value often eaten for pleasure (Cook and Meursing, 1982).

According to Ogunmoyela and Birch (1984) chocolates, like most confectionery products, are readily digestible and thus provide easily absorbable energy, which makes a valuable contribution to the nutrition component of the diet. The properties of chocolate can essentially be summarised as having restorative, energy producing and toxic effects on the body (Mossu, 1992). The habitual use of cocoa products as a dietary supplement, favours correction of the negative effects of long term feeding with a diet moderately deficient in magnesium (Planells *et al.*, 1999). Cocoa can be a potent inhibitor of iron absorption (Hurrell *et al.*, 1999). Chocolate milk provides more zinc, potassium, niacin and riboflavin than plain whole milk (Saran, 2001).

The polyphenols and their reactants may be the anti-carcinogenic factor observed in chocolate (Singleton and Kratzer, 1973; Singleton, 1981). Flavanoids are compounds which are present in cocoa, may reduce the risk of developing heart disease or cancer. Studies confirmed that antioxidant potential of individual polyphenols or flavonoids present in cocoa and certain chocolate have high levels of antioxidants (Wood and Lass, 1985). The polyphenols found in cocoa bean have been found to have a strong inhibitory effect on rheumatoid factor and the production of inflammatory cells and also to inhibit the production of IgE - an immunoglobulin that exacerbates atopic dermatitis and asthma (Sarsai, 1997). It is believed that chocolate is stable against oxidative deterioration on account of the presence of polyphenolic compounds, and it is also expected to have a protective role (Osakake *et al.*, 1998). According to Vinson *et al.* (1999) chocolates may

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provide additional antioxidant protection for low density lipoprotein and thus may be beneficial for preventing heart disease. Antioxidants in cocoa products may reduce the risk of developing cancer and heart diseases and as well as offer some antiaging health benefits (Saran, 2001).

The derivatives of cocoa, especially chocolates are causative of migraines. The effect has been attributed to the presence of tyramine in them (Jalon *et al.*, 1983). The anti ulcer activity of cacao liquor was examined by Osakake *et al.* (1998). The results suggest that the anti ulcer mechanism of cacao liquor was not only radical scavenging but also modulation of leucocyte function. According to Rogers (1998) many people describe their desire to eat chocolate and they also report that eating chocolate relieves tension. A chemical called serotonin is thought to relax and calm people. Endorphins are another group of chemicals that are thought to produce the feel good factor. Study conducted by Kamiwaki *et al.* (1999) concluded that lignins from cacao bean husk may suppress the increase of blood pressure and serum levels of total cholesterol. Ordinary cocoa and chocolate bars contain a group of alkaloids known as tetrahydrobeta-carbolines, chemicals linked to alcoholism (Rangarajan, 2000).

According to Rein *et al.* (2000) cocoa consumption suppressed adenine diphospho nucleotide (ADP) or epinephrine stimulated platelet activation and platelet microparticle formation. Cocoa consumption had an aspirin like effect on primary hemostasis. Chocolates are also known to contain catechins, chemicals that prevent cancer and heart disease (Barrie, 2000). Studies have confirmed that

tannic acid in chocolate inhibit the formation of dental plaque and cocoa butter, one of the highest natural sources of stearic acid, does not raise blood cholesterol (Saran, 2001).

2.3 Processing of cocoa

The green pods of cocoa turns yellow and the red pod turns orange at harvest stage. The pods are harvested by making a clean cut through the stalk with a well sharpened blade (Mossu, 1992). According to Prasannakumari Amma *et al.* (2000) it takes about 150-170 days from pollination for attaining harvest stage. The stage of maturity of pods is best judged by change of colour of pods.

Cocoa beans when taken out of the pods are covered with mucilage or pulp. Removal of this pulp adhering to the bean is brought about through fermentation (Abarham, 1983). Proper fermentation and drying is an essential pre requisite for obtaining processed beans of acceptable quality (Bopaiah and Shantaram, 1990). Fermentation of *Theobroma cacao* seeds has been considered to be the most important factor influencing cocoa flavour (Figueira *et al.*, 1997). Beans fermented for four days by mix culture were preferred to those naturally fermented (Bhumibhamon *et al.*, 1997). A seven day fermentation trial was carried out by Broadbent *et al.* (1997) using the traditional wooden box and the method commonly used in West Africa, of a heap in banana leaves, there was no difference in the level of enzyme activity.

During fermentation complex chemical changes in polyphenol occur which affect the flavour and colour of chocolates. Anthocyanins are hydrolysed

enzymatically to autocyanidins which polymerize along with simple catechins to form high molecular weight leucocyanidins or complex tannins (Roelofsen, 1958; Forsynth and Quesnel, 1963). Weisberger (1971) observed the presence of a range of both volatile and non volatile organic acids during fermentation of cocoa beans. These were found to contribute to the characteristic flavour of the end product. According to Berbert (1979) after six days of fermentation the sucrose in cocoa was totally hydrolysed. According to Stebert *et al.* (1996) the longer the cocoa beans are fermented, the more polyphenols are lost and less astringent the beans will be. Secondary fermentation resulted in lower acidities and smaller fat losses compared to roasting (Nibesny and Rutkowski, 1998). Enzymes are of key importance in flavour precursor formation and in pigment degradation during cocoa fermentation (Hasen *et al.*, 1998).

During the drying stage epicatechins and leucocyanidins are oxidised enzymatically resulting in the brown colour characteristics of chocolate (Griffith, 1957; Quesnel, 1966). The rate of drying varies greatly according to the method employed. If drying is too slow there is the danger of beans getting mouldy and consequent development of off flavour. Too quick drying using artificial driers may lead to the beans remaining acidic (Abraham, 1983). According to Mossu (1992) the aim of drying is to reduce the water content of the fermented beans to less than eight per cent. Good drying practices relate to the flavour quality of chocolate (Stebert *et al.*, 1996). Study conducted by Hasen *et al.* (1998) showed that enzymes including endoprotease and glycosidases were still active in properly

dried beans. Another study conducted by Dharmaputra *et al.* (1999) concluded that the free fatty acid content of cocoa beans tended to be higher during wet season. Optimum drying methods are carried out to achieve high fructose and glucose content, an important factor for proper development of the chocolate flavour during the subsequent roasting (Mulato *et al.*, 1999).

Roasting is generally considered to cause the reaction of sugars and amino acids leading to a decrease in the levels of free sugars (Cerbulis, 1955). Over 300 volatile compounds have been identified in roasted cocoa beans (Keeney, 1972). Further changes during roasting and cunching may occur to affect chocolate flavour. Although most polyphenols are reduced during fermentation and drying, they are still present in chocolate and impart astringent and bitter taste (Singleton and Kratzer, 1973; Singleton, 1981). Roasting develops flavour and colour and facilitates the removal of shell (Wood, 1975).

Beans roasted for cocoa powder are subjected to a higher temperature than those roasted for chocolate (Wood and Lass, 1985). Pyrazines (1,4 diazines) represent about forty percent of the compounds, identified in the aromatic fraction of chocolate (Maya, 1992). Roasting of cocoa beans causes changes in the chemical structure of polyphenols producing less astringent compounds (Manay and Swamy, 1995). Higher temperature decreases the polyphenol content to a greater extent (Stebert *et al.*, 1996). Pyrazines are significant contributors to the flavour of roasted cocoa (Hasim and Selamat, 1997). A study conducted by Nibesny and Rutkowski (1998) revealed that there was a decrease of total and

volatile acidity and an inevitable increase of cocoa fat loss with increasing temperature. According to Jaiswal (1999) roasting is the only step where salmonella can be killed if present in raw beans. It is critical to roast beans in a specified temperature and time.

The roasted nibs are ground in a grinder. The heat of grinding melts the fat and the ground material acquires a fluid consistency due to the presence of large amounts of fat. This is known as cocoa mass and it contains 55-58 per cent cocoa butter (Wood and Lass, 1985). The fat present in the ground nib is pressed out in a screw press to obtain cocoa butter (Swaminathan, 1979). Cocoa butter is the premier confectionery fat because of its special physical properties, unique taste and flavour (Tsai *et al.*, 1982). Cocoa butter, also called theobroma oil is a pale yellow, edible vegetable fat obtained from cocoa beans. It has a mild chocolate flavour and aroma and used in the manufacture of chocolate confectioneries, pharmaceutical ointments and toiletries. It is valued for its melting characteristics remaining brittle at room temperature. It also contains antioxidants that discourage rancidity and allow storage life of two to five years (Gwinn *et al.*, 1992).

Study conducted by Hartel (1996) noticed that cocoa butter and milk fat fractions show that softening occurs due to both dilution effect and a slight eutectic formation. Results indicated that long chain mono unsaturated triglycerides from cocoa butter enhanced co-crystallization and cooperative melting (Simoneav and German, 1996). Cocoa butter is the major commercial product from seeds of

Theobroma cacao (Pires *et al.*, 1998). Cocoa butter is a solid substance at ordinary temperature but softens at 25°C. The fatty substance may consist of oleine, stearine, palmitens, laurine and free fatty acids and are mostly soluble in ether, but not in cold alcohol (Wright, 1999). Though cocoa butter is an ultimate fat in chocolate, it is not adequate for use in warm climates as it softens (Nirupama and Reddy, 2000).

2.4 Acceptability studies of dairy products with cocoa mass

It has been recognised that enjoyment of food is essential for good health. Enjoyment would mean choice and acceptance and not always nutrition and whole someness (Solms and Hall, 1981). Measuring the sensory properties and determining the importance of these properties as a basis for predicting acceptance by the customer, represents major accomplishments for sensory evaluation (Bodyfelt *et al.*, 1988). For consumers, the perceivable sensory attributes like colour, appearance, feel, aroma, taste and texture are the deciding factors in food acceptance (Pal *et al.*, 1995). According to Venigi (1997) sensory methods are used to evaluate the quality of food as well as to determine consumer preferences among food items. A key component of confectionery growth is chocolate, which recently has benefitted from scientific studies (Hollingsworth, 1999).

The use of irradiated cocoa in the manufacture of chocolate - ice-cream was investigated by Rodriguez *et al.* (1995) in order to eliminate the need for heat treatment of the cocoa and thus to shorten manufacturing time. It was concluded that chocolate ice cream of good microbiological and organoleptic quality could be

manufactured using irradiated cocoa. Non fat, low fat, reduced fat and full fat chocolate ice-creams were standardized by Prindivilla *et al.* (1999). They showed that ice-creams containing higher milk fat concentrations are better protected against heat shock damage in terms of cocoa flavour and smoothness of texture.

Hartel (1996) documents that high melting fractions like milk fat, incorporated into chocolates drastically reduced bloom formation and cause less softening than anhydrous milk fat.

Yabiku and Kimura (1996) estimated theobromine and caffeine in 77 samples of products based on cocoa or chocolate, milk chocolate had 0.15 to 0.04 per cent respectively.

According to Gonze *et al.* (1997) it is possible to produce good quality chocolate with 23 per cent less calories; further decrease in the content of cocoa butter together with the use of defatted cocoa powder and the emulsifier polyglycerol polyvicinoleate has achieved the 30 per cent target with inferior mouth feel.

Milk chocolates (30% total fat) were formulated by replacing cocoa butter at various concentrations with milk fat fractions. A significant decrease in hardness of the chocolate was observed as the concentration of milk fat was increased. No significant differences in viscosity were detected among the samples at 40°C. However, a noted change in milk chocolate viscosity was seen during tempering (Dimick *et al.*, 1997).

Bricknell and Hartel (1998) studied the polymorphic changes in cocoa butter crystals using X-ray diffraction. Visual bloom appeared rapidly on special chocolates made with anhydrous milk fat, middle and low melting fractions, whereas visual bloom was very slow to appear on the special chocolates made with high melting milk fat fraction and on the cocoa butter control.

Soya-milk chocolate was prepared by a simple panning process which included condensation of milk in a pan with successive addition of ingredients. Chocolate remained organoleptically acceptable upto 45 days of storage at room temperature (Gojiya and Patel, 1998)

A study conducted by Paz. Frassino *et al.* (1998) on the development of chocolate flavoured soya bean beverage concluded that it was of good microbiological and physiochemical quality and it was 'liked very much' by ninety percent and 'liked' by ten percent of consumers.

A study was conducted by Cuinard and Mazzucchelli (1999) on the sensory properties of milk chocolate formulations varying in sucrose and cocoa butter. Low sugar samples were more bitter, gritty and roasted. High sugar samples had higher milky, hardness and sweetness intensities. Samples higher in fat were faster in melting. Low sugar and low fat samples were associated with viscous and mouth coating cocoa. Samples with high levels of sugar and fat were more cooling and faster vanishing. Fat intensity was inversely related to fat concentration

A study was done by Jorge *et al.* (1999) upon the advantages and disadvantages of the replacement of dried whole milk by soya milk in chocolate

manufacture. It was concluded that it is possible to use upto 3 per cent of dried soya milk in chocolate, which to some extent improves creaminess and nutritional value without significantly affecting its organoleptic characteristics.

A study was conducted by Nirupama and Reddy (2000) on the effect of cocoa butter extender prepared from mahua and kokum fat in improving heat resistance property of dark and milk chocolate. It was found that addition of cocoa butter extender increased the hardness of both dark and milk chocolate samples, the effect being directly related to the percentage of addition. The results indicated that the heat and fat bloom resistance properties of dark and milk chocolate were improved.

A chocolate bar comprising wheat, milk, dry fruits and nuts, sucrose, glucose, fat and flavours was highly acceptable both among laboratory panel members and the adolescent players. Study confirmed the beneficial effect of the chocolate bar as a pre-game snack for an adolescent sport person on endurance game (Shivaleela, 2000).

Materials and Methods

3. MATERIALS AND METHODS

The study on standardisation and acceptability of dairy products with cocoa mass was aimed to standardize dairy products incorporated with cocoa mass and to evaluate the acceptability.

3.1 Collection of the sample

Fermented and dried cocoa beans were procured from Cadbury Cocoa Research Project (CCRP), College of Horticulture, Kerala Agricultural University, Vellanikkara.

3.2 Selection of judges for acceptability studies

A series of acceptability trials were carried out using simple triangle test as suggested by Jellinek (1985) to select a panel of 15 judges as technical experts, 30 school going children from the Kerala Agricultural University school and 30 college students from College of Horticulture.

3.3 Research method

3.3.1 Preparation of cocoa mass

An iron pan was pre heated for 10 minutes at simmering temperature and 1 kg of fermented and dried cocoa seeds was roasted for 5 minutes, stirring constantly. The roasted seeds were then lightly rolled with a roller to remove outer seed coat. The seed coats were then removed by winnowing and the seeds collected were then powdered in a mixie. The powder was then passed through a plastic sieve to get a uniform powder. Another lot of cocoa beans were roasted for 10 minutes duration in the same manner as described and powdered (Plate 1 and Plate 2).



Plate 1. Roasted cocoa beans for 5 minutes and 10 minutes

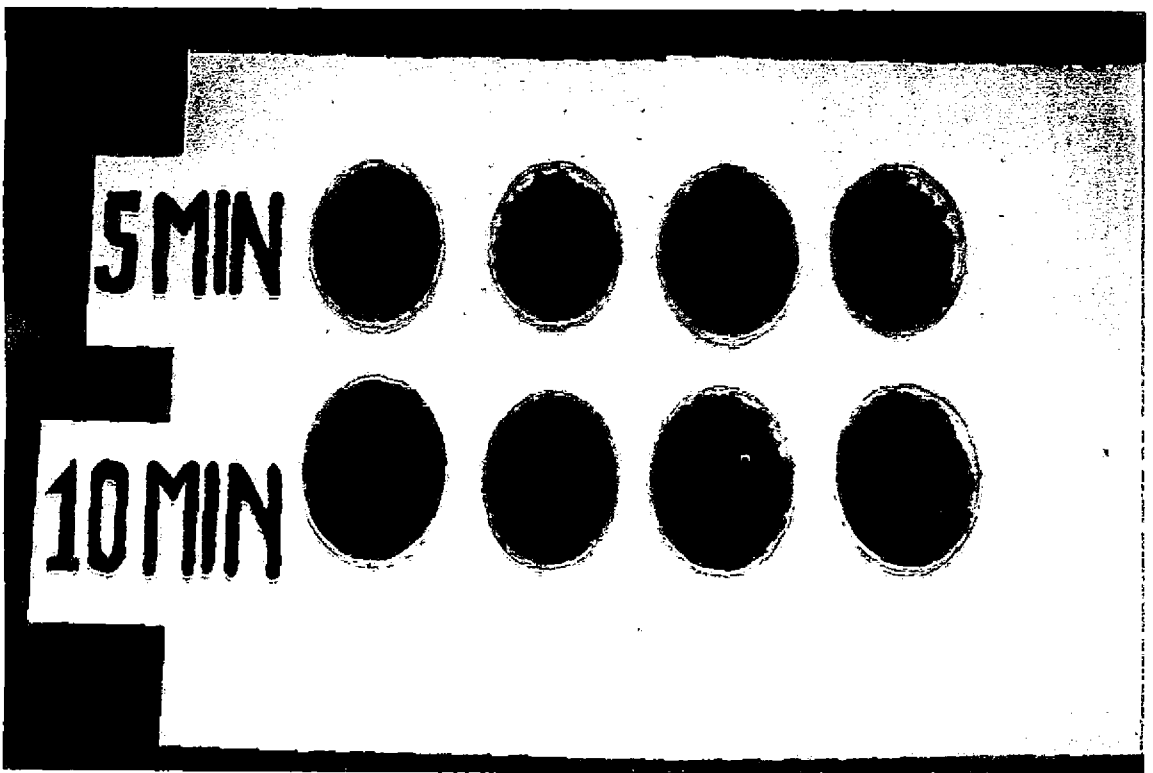


Plate 2. Stored cocoa mass

3.3.2 Keeping quality of cocoa mass

The cocoa mass was stored in glass containers under ambient conditions for 3 months and the following qualities were assessed at monthly intervals.

3.3.2.1 Free flowness

A small amount of cocoa powder is handled between the fingers to assess free flow. Formation of lumps if any was noted.

3.3.2.2 Solubility

One gram of cocoa weighed into a test-tube was dissolved in 10 ml of warm distilled water to assess its solubility.

3.3.2.3 Microbial count

The microbial load of the stored cocoa mass was assessed at monthly intervals by standard plate count method (AOAC, 1976). The media used for detecting the presence of bacteria and fungi were nutrient agar and potato dextrose agar respectively.

3.3.2.4 Peroxide value

Peroxide value was assessed to find the rate of rancidity of cocoa mass during storage. It was estimated by the method suggested by Sadasivam and Manickam (1992). The peroxide present was determined by titration against thiosulphate in presence of potassium iodide using starch as the indicator.

3.3.3 Standardization of products with cocoa mass

Five milk based products namely milk chocolate, burfi, fudge, milk biscuits (salt) and icecream were selected for incorporating cocoa mass. Five per cent and 10 per cent of the milk used in the standard dairy product was replaced by cocoa mass. The products were standardized with cocoa mass prepared by roasting

the cocoa beans for five minutes and 10 minutes. The proportion of various raw ingredients used are given in tables.

Table 1. Proportion of ingredients in milk chocolate

Ingredients	Milk chocolate control (gm)	5% cocoa mass incorporated milk chocolate (gm)	10% cocoa mass incorporated milk chocolate (gm)
Milk	1000	1000	1000
Sugar	350	350	350
Cocoa powder	25	-	-
Maida	15	15	15
Ghee	15	15	15
Cocoa mass	-	50	100

Method

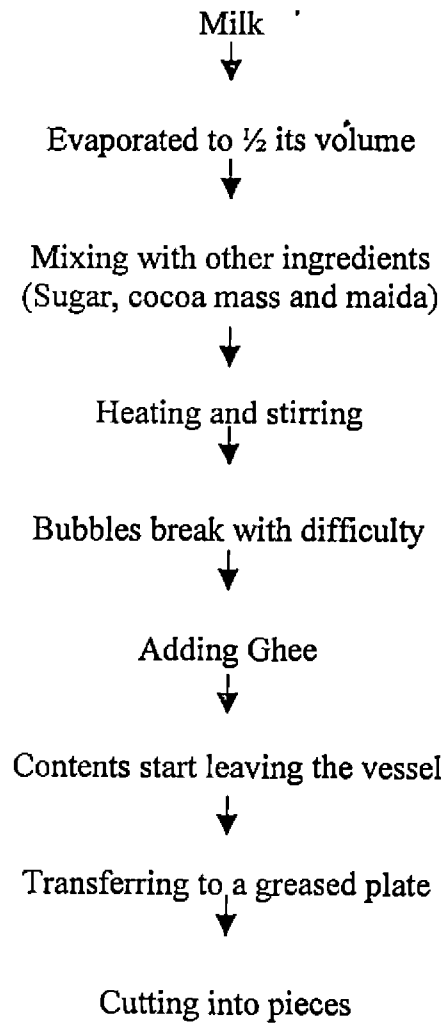
- Milk was evaporated to half its volume
- Cocoa mass and maida were mixed separately in a small portion of milk and added to the above
- Sugar was added and stirred continuously
- Ghee was added when bubbles began to break
- When the mixture started leaving the vessel it was removed from the fire
- Transferred to a greased tray and cut into pieces

Flow chart for the preparation of milk chocolate is given in Fig.1.

Table 2. The proportion of ingredients in burfi

Ingredients	Burfi control (gm)	5% cocoa mass incorporated burfi (gm)	10% cocoa mass incorporated burfi (gm)
Khoa	500	500	500
Sugar	150	150	150
Cocoa mass	-	25	50

Fig.1. Flow chart for the preparation of milk chocolate



Method

- Khoa, sugar and cocoa mass were mixed together and warmed on a slow flame
- After 5-10 minutes a small portion of mixture was tested to see if it formed a soft ball between the fingers
- When done, the mixture was spread on a flat vessel and allowed to cool
- It was cut into diamond shapes.

Flow chart for the preparation of burfi is given in Fig.2.

Table 3. The proportion of ingredients in fudge

Ingredients	Fudge Control (gm)	5% cocoa mass incorporated fudge (gm)	10% cocoa mass incorporated fudge (gm)
Cocoa powder	40	-	-
Sugar	300	300	300
Butter	40	40	40
Cashew nut	20	20	20
Milk	400	400	400
Cocoa mass	-	20	40

Method

- Cocoa mass and milk were mixed without any lumps
- On a low flame butter was melted in a heavy pan and the sugar was evenly browned
- Keeping on the low flame cocoa mass and milk mixture was added to the melted butter and sugar stirred continuously
- Heated the mixture to a soft ball stage
- Added chopped cashew nuts
- Poured on to a greased plate. When set, it was cut into pieces.

Flow chart for the preparation of fudge is given in Fig. 3.

Fig.2. Flow chart for the preparation of burfi

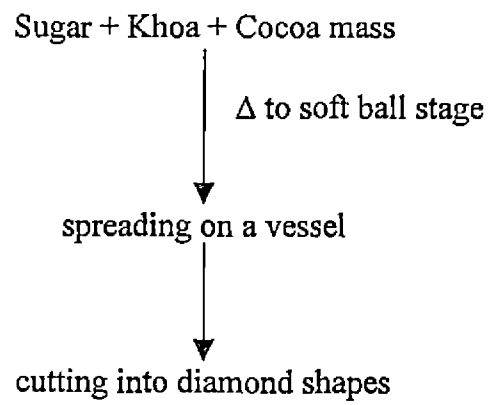


Fig.3. Flow chart for the preparation of fudge

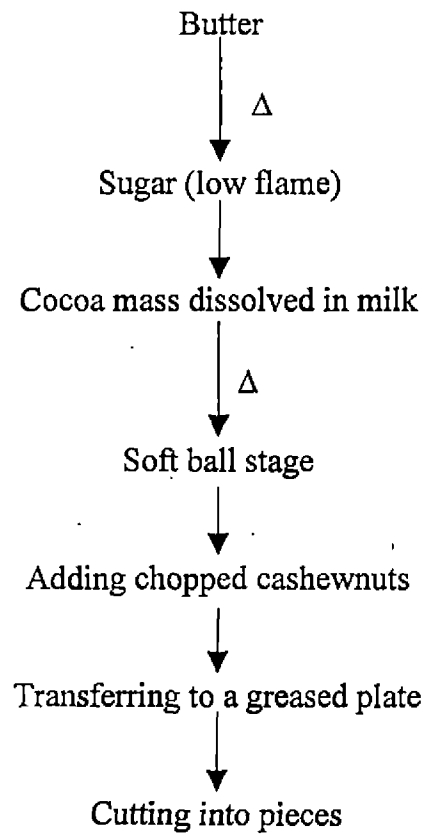


Table 4. The proportion of ingredients in milk biscuit (salt)

Ingredients	Milk biscuit control (gm)	5% cocoa mass incorporated milk biscuit (gm)	10% cocoa mass incorporated milk biscuit (gm)
Maida	230	230	230
Milk	170	170	170
Baking powder	15	15	15
Salt	5	5	5
Dalda	80	80	80
Cocoa mass	-	8.5	17

Method

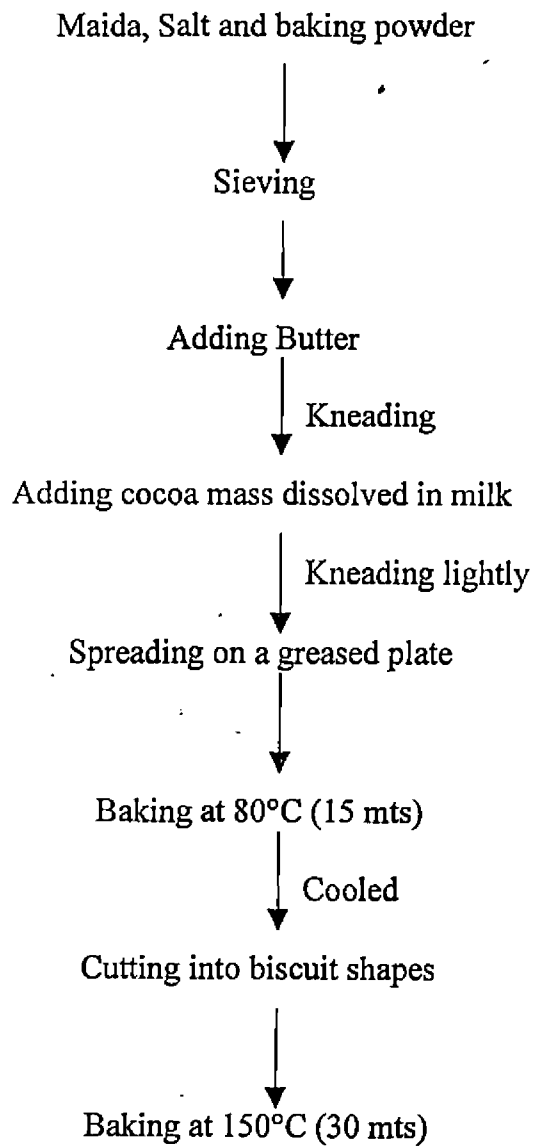
- Maida, baking powder and salt were sifted together
- Dalda was added and kneaded to make the mixture mealy
- Cocoa mass dissolved in milk was added to the above mixture and kneaded lightly
- Spread on a greased plate and baked in a preheated oven for 15 minutes at 80°C
- Cooled and with the help of a biscuit cutter it was cut into biscuits
- Again baked at 150°C for 20-30 minutes

Flow chart for the preparation of milk biscuit is given in Fig.4.

Table 5. The proportion of ingredients in ice cream

Ingredients	Ice cream control (gm)	Ice cream with 5% cocoa mass incorporation (gm)	Ice cream with 10% cocoa mass incorporation (gm)
Cream	40	40	40
Milk	620	620	620
Sugar	150	150	150
Milk powder	50	50	50
Stabilizer + emulsifier (GMS+gelatin)	5	5	5
Cocoa mass	-	31	62

Fig.4. Flow chart for the preparation of milk biscuit (salt)



Method

- Milk powder and sugar were mixed well
- To the above mixture, cream and cocoa mass dissolved in milk were added and blended
- It was warmed to 70°C by stirring (till vapour came)
- Cooled, gelatin and glycerol mono stearate (GMS) were added and stirred well
- The mixture was double boiled upto 80-82°C
- Cooled to room temperature
- Then it was kept at the lower part of the fridge for 5-6 hours
- When almost set beat in a mixie for 2-3 minute
- Kept in deep freezer for 2-3 hours

Flow chart for the preparation of ice cream is given in Fig.5.

3.3.4 Organoleptic evaluation of products incorporated with cocoa mass

Organoleptic evaluation of different samples was done by 15 technical experts, 30 school children and 30 college students selected as panel of members.

Acceptability trials were conducted using the scoring method (Swaminathan, 1974). The score cards prepared for the organoleptic evaluation of the sample is given in Appendix I. Five quality attributes like appearance, colour, flavor, texture and taste were included for each sample. Each of the above mentioned quality was assessed on a five point hedonic scale. The judges were requested to taste one sample at a time observing the standard procedure for the sensory evaluation by the panel members (Plates 3, 4 and 5). Products were also made with cocoa mass stored for 3 months at monthly intervals and assessed their organoleptic qualities.

Fig.5. Flow chart for the preparation of ice cream

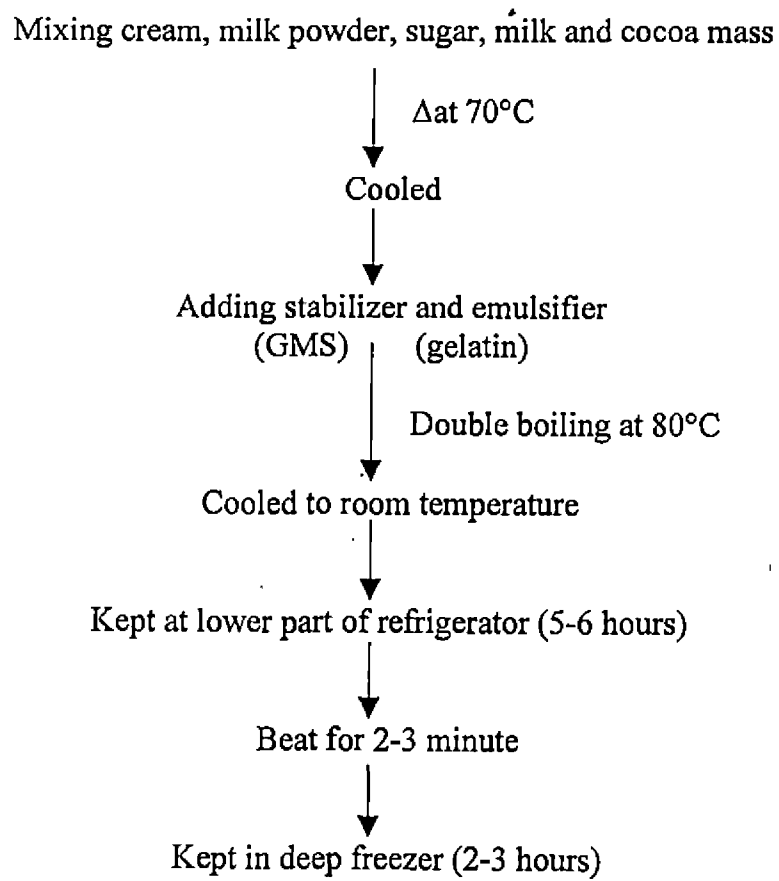




Plate 3. Cocoa products incorporated with cocoa mass (5 minutes roasting) at 5% and 10% level

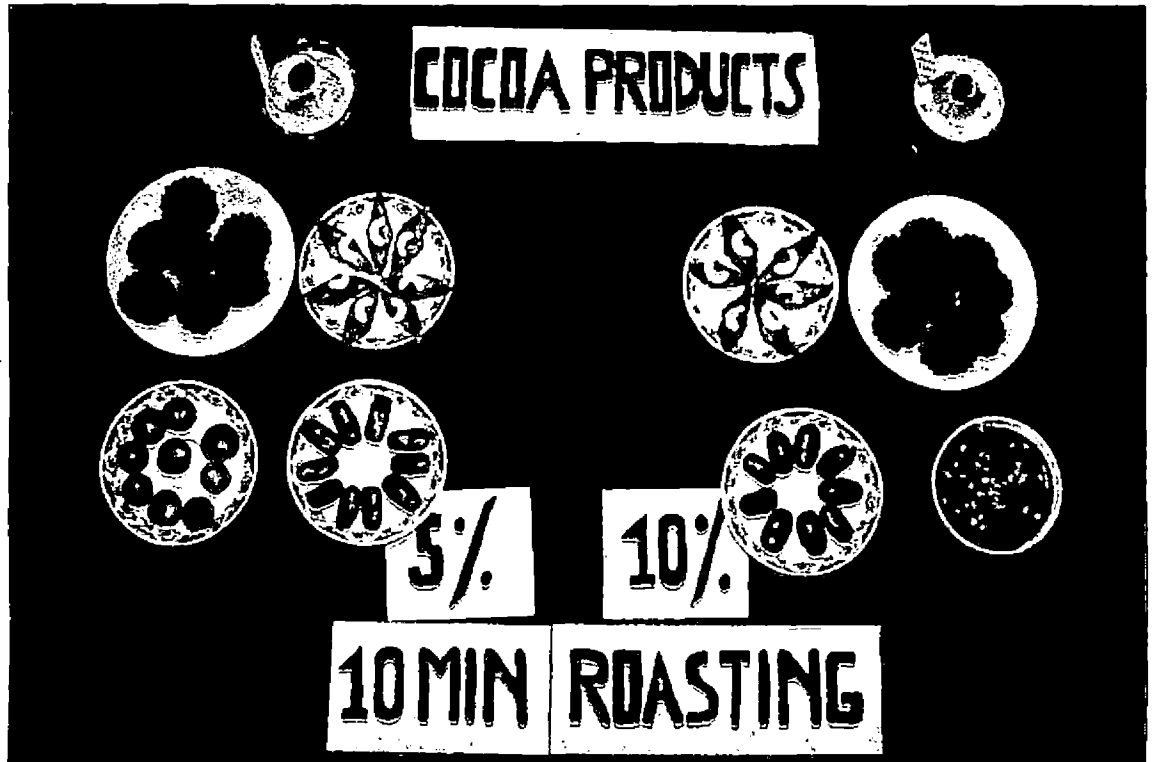


Plate 4. Cocoa products incorporated with cocoa mass (10 minutes roasting) at 5% and 10% level

Results

4. RESULT

Salient findings of the study entitled standardisation and acceptability of dairy products with cocoa mass are presented under following sections.

4.1 Keeping quality of cocoa mass

4.1.1 Assessment of free flowness

The roasted and powdered cocoa beans which was stored in glass containers under ambient conditions showed the tendency of becoming clumped as the storage time progressed. Time of roasting of cocoa beans made no difference in this property. The powder was found to be free flowing initially and it gradually clumped by the third month. A colour change was also noticeable during storage. It became pale brown in colour by the end of third month.

4.1.2 Solubility of cocoa mass

Solubility of cocoa mass prepared by 5 min roasting and 10 minute roasting of cocoa beans was assessed at monthly intervals for a period of 3 months. As such the solubility of cocoa mass in warm water was not satisfactory. There was not much change in this property due to storage.

4.1.3 Total plate count of cocoa mass

Microbial population of the cocoa mass was assessed at monthly intervals for a period of three months and the results are presented in Table 6.

Table 6. Microbial population in cocoa mass

Period of storage in months	Microbial population (cfu/g)					
	Fungus			Bacteria		
	5 minute roasting	10 minute roasting	't' value	5 minute roasting	10 minute roasting	't' value
Initial	2.0	1.5		7.5	4.0	
I	4.5	3.5	2.73*	9	4.5	4.33**
II	5.0	3.5		13.5	8.0	
III	7.5	4.0		26.0	23.0	

* Significant at 5% level

** Significant at 1% level

As revealed in Table 6 both fungal and bacterial load in cocoa mass increased with storage. The initial fungal load for cocoa mass prepared by 5 minute roasting was 2 cfu/g which gradually increased to 4.5, 5 and 7.5 cfu/g during the first, second and third month respectively. When compared with cocoa mass prepared by 5 minute roasting, the cocoa mass prepared by 10 minute, roasting showed a decrease in fungal load but here also the fungal load increased with period of storage. The fungal load of cocoa mass prepared by 10 minute roasting was 1.5 cfu/g initially which gradually increased to 3.5 and then to 4 cfu/g during the first second and third months respectively. The fungal load of cocoa mass prepared by 10 minute roasting was significantly low when compared with fungal load of cocoa mass prepared by 5 minute roasting.

The initial bacterial load in cocoa mass prepared by 5 minute roasting was found to be 7.5 cfu/g which increased gradually to 26 cfu/g during the third month. First month and second month having 9 cfu/g and 13.5 cfu/g respectively. The tendency of formation of bacterial colonies in cocoa mass prepared by 10 minute roasting was found to be significantly low. Initially it had only 4 cfu/g

which gradually increased to 23 cfu/g. First month and second month having 4.5 cfu/g and 8 cfu/g respectively (Fig.6).

4.1.4 Peroxide value

The mean peroxide value estimated in cocoa mass prepared by 5 minute and 10 minute roasting of cocoa beans is presented in Table 7.

Table 7. Mean peroxide value in cocoa mass (m. eq/kg)

Period of storage in months	Peroxide value (m. eq/kg)	
	5 minute roasting	10 minute roasting
Initial	1.1	0.70
I month	1.4	0.90
II month	1.9	1.34
III month	2.0	1.40

As revealed in Table 7 initially the mean peroxide value was low for 5 minute roasting (1.1 m. eq/kg) and even low for 10 minute roasting (0.7 m. eq/kg). The mean peroxide value increased to 1.4 m. eq/kg during the first month of storage and reached 2 m. eq/kg during third month of storage in cocoa mass prepared by 5 minute roasting. The same trend was observed in cocoa mass prepared by 10 minute roasting, the mean peroxide value reaching up to 1.4 m. eq/kg during the third month (Fig.7).

4.2 Organoleptic evaluation of products made with cocoa mass at monthly intervals

The results of the organoleptic studies conducted with the products prepared by incorporating cocoa mass at 5 and 10 per cent levels are presented and the abbreviations used in the following tables are explained below.

Fig. 6. Microbial population of cocoa mass on storage

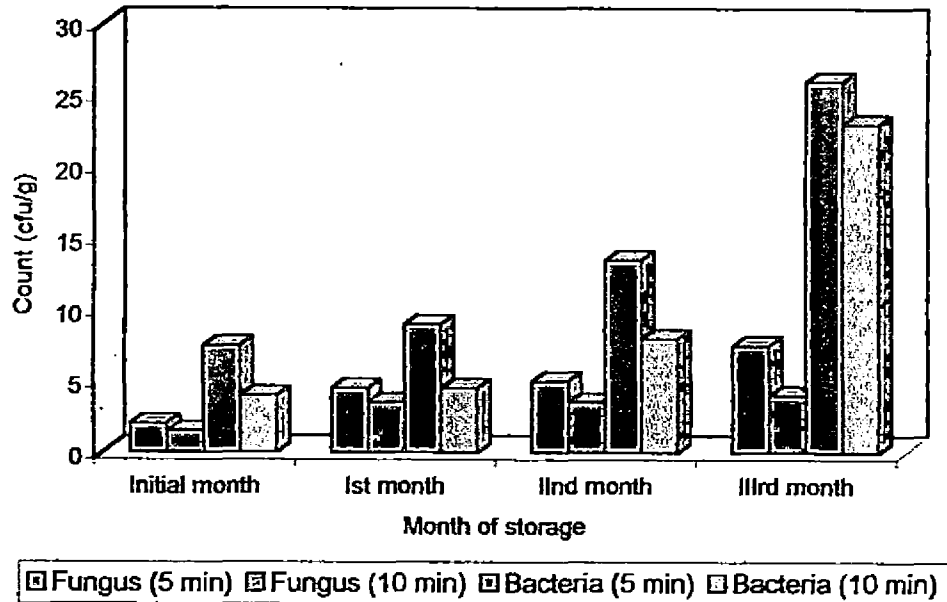
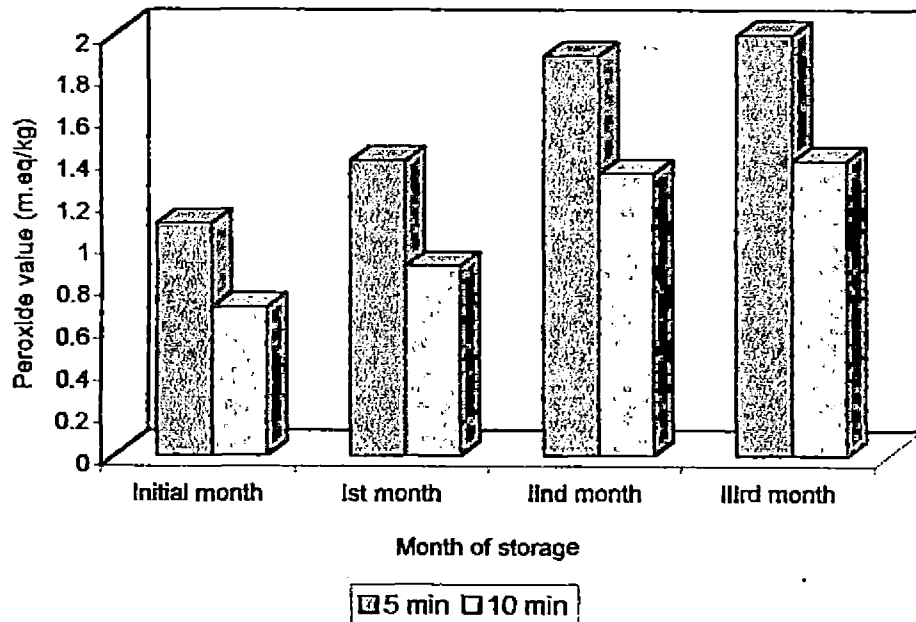


Fig. 7. Peroxide value of cocoa mass on storage



- T₁ – Cocoa mass made by roasting cocoa beans for 5 minutes and incorporating at 5 per cent level
- T₂ – Cocoa mass made by roasting cocoa beans for 5 minutes and incorporating at 10 per cent level
- T₃ – Cocoa mass made by roasting cocoa beans for 10 minutes and incorporating at 5 per cent level
- T₄ – Cocoa mass made by roasting cocoa beans for 10 minutes and incorporating at 10 per cent level

Period of storage

P₀ – Initial

P₁ – First month

P₂ – Second month

P₃ – Third month

CD – Critical difference

PM – Period mean

TM – Treatment mean

Table 8a indicates the total mean score in percentage with regard to the acceptability of appearance of milk chocolate for different storage periods.

Table 8a. Acceptability of appearance of milk chocolate (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	78.67	80.47	84.00	80.00	80.95
T ₂	68.43	59.77	62.20	55.57	61.49
T ₃	78.87	82.43	78.47	79.30	79.72
T ₄	68.67	60.43	56.00	54.40	59.88
Period mean	73.66	70.77	70.17	67.45	

1) CD for comparison of PM - 8.1^{NS}

2) CD for comparison of TM - 5.106**

3) CD for TM within period - 10.21^{NS}

** Significant at 1% level

NS- Non significant

The acceptability of T₁ increased from a total mean score of 78.67 per cent to 84 per cent, the second month ranking the highest. Total mean score was minimum for the 3rd month (80%).

T₂ obtained lower mean scores than T₁. The total mean score of 68.43 per cent obtained initially decreased to 55.57 per cent by the third month.

For T₃ the total mean score ranged from 78.87 per cent to 82.43 per cent. The maximum score of 82.43 per cent was obtained for the first month.

For T₄ maximum mean score was for the initial period (68.67%) which decreased gradually to 54.4 per cent during the third month. First and second month obtained total mean score of 60.43 and 56 per cent respectively.

The comparison of Period mean and Treatment mean within period was found to be non significant though the value of period mean varied between 73.66 per cent initially to 67.45 per cent during the third month. There was a significant difference in the Treatment mean the value varied between 80.95 per cent to 59.88 per cent.

Table 8b projects the acceptance of colour of milk chocolate for different storage periods.

Table 8b. Acceptability of colour of milk chocolate (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	71.10	77.10	78.67	77.30	76.04
T ₂	70.67	71.57	67.77	64.87	68.72
T ₃	79.57	81.30	74.90	75.57	77.84
T ₄	69.30	71.57	68.03	67.57	69.12
Period mean	72.67	75.39	72.34	71.32	

1) CD for comparison of PM - 5.60^{NS}

2) CD for comparison of TM - 3.77**

3) CD for TM within period - 7.55^{NS}

** Significant at 1% level

NS- Non significant

T₁ during the initial month had a total mean score of 71.1 per cent which increased to a maximum of 78.67 per cent by the second month. First and third month obtained 77.1 and 77.3 per cent respectively.

In T₂ the acceptance of colour was high during the first month (71.57%) when compared to the initial score (70.67%); The scores decreased to 67.77 per cent and 64.87 per cent during the second and third months respectively.

In T₃ initial and first month had a high acceptability with a score of 79.57 per cent and 81.3 per cent respectively. A minimum score of 74.9 per cent was obtained for the second month.

The acceptability of colour in T₄ showed that the total mean score during the initial month was 69.3 per cent which increased to 71.57 by the first month. Then a gradual reduction in the total mean score was observed during second and third month respectively (68.03 and 67.57%).

Difference in the Treatment mean of colour of milk chocolate was found to be significant. Treatment mean was highest for T₃ (77.84%) and lowest for T₂ (68.72%). There was no significant difference observed for Period mean.

Table 8c presents the acceptance of flavour of milk chocolate for different storage periods.

Table 8c. Acceptability of flavour of milk chocolate (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	76.43	78.90	78.00	75.57	77.22
T ₂	71.57	66.03	67.10	65.57	67.57
T ₃	74.87	82.00	76.43	71.97	76.32
T ₄	65.53	69.10	66.00	64.43	66.27
Period mean	72.10	74.00	71.88	69.38	

1) CD for comparison of PM - 7.25^{NS}

2) CD for comparison of TM - 3.48**

3) CD for TM within period - 6.96^{NS}

** Significant at 1% level

NS- Non significant

The flavour was highly acceptable for T₁ and this had the highest Treatment mean score (77.22%) when compared to other treatments. The total mean score was found to be 76.43 per cent initially which increased to a maximum score of 78.9 per cent during the first month. The total mean score then decreased to 78 per cent and then to 75.57 per cent for the second and third month respectively.

The acceptability was found to be decreasing for T₂. Initial score being 71.57 per cent. The least score was for the third month (65.57%).

In T₃ first month had the highest score of 82 per cent, and the lowest score of 71.97 per cent was noticed during the third month.

In T₄ also first month scored highest (69.1%) and the third month obtained the lowest score of 64.43 per cent. The mean score for treatment was also found to be low (66.27%) when compared with other treatments.

Difference in the Period means and Treatment means within period were not significant though the value of Period mean ranged between 74 per cent during first month to 69.38 during the third month. Differences in the Treatment means was found to be significant. Treatment mean of T₁ scored highest (77.22%) followed by T₃ at 76.32 per cent.

Table 8d reveals the acceptability of texture of milk chocolate for different storage periods.

Table 8d. Acceptability of texture of milk chocolate (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	73.37	77.10	77.76	74.23	75.62
T ₂	57.77	54.00	60.90	54.00	56.72
T ₃	74.67	80.23	71.13	75.10	75.28
T ₄	60.43	61.53	57.57	50.00	57.49
Period mean	66.56	68.27	66.84	63.44	

1) CD for comparison of PM - 6.68^{NS}

2) CD for comparison of TM - 4.61**

3) CD for TM within period - 9.22^{NS}

** Significant at 1% level

NS - Non significant

In T₁ maximum score for texture was obtained for the second month (77.76%) followed by the first month (77.1%). The initial score obtained for texture was found to be least (73.37%).

In T₂ the scores obtained were found to be comparatively low, the maximum score of 60.9 per cent recorded for the second month. Initially the score was 57.77 per cent which reduced to 54 per cent during the third month. Treatment mean was also low (56.72%) when compared with other treatments.

The total mean score for T₃ was found to be highest (80.23%) during the first month and lowest (71.13%) during the second month.

In T₄ the initial score was 60.43 per cent during the first month and the highest score was for the second month (61.53%). Then a gradual reduction in the total mean scores from 57.57 per cent in second month to 50 per cent for the third month was observed.

Critical differences was not significant for Period mean and Treatment mean within period. The Treatment mean was found to be highest for T₁ (75.62 %)

followed by T_3 at (75.28%) and the least for T_2 (56.72%). The differences in the Treatment means were found to be significant.

The acceptability of taste of milk chocolate for different storage periods is presented in Table 8e.

Table 8e. Acceptability of taste of milk chocolate (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	82.63	84.43	81.66	78.67	81.83
T ₂	71.33	68.03	69.10	62.67	67.78
T ₃	84.23	83.13	78.63	75.57	80.83
T ₄	58.67	70.20	61.77	62.67	63.33
Period mean	74.22	76.45	72.77	69.89	

1) CD for comparison of PM - 7.34^{NS}

2) CD for comparison of TM - 4.35**

3) CD for TM within period - 8.69^{NS}

** Significant at 1% level

NS- Non significant

The taste of milk chocolate for T_1 was high during the first month (84.43%) and least score during the third month (78.67%). When compared to other treatments treatment mean score was maximum for T_1 (81.83%).

In T_2 the total mean score varied from 71.33 per cent initially to 62.67 per cent for the third month. In this treatment taste obtained a better score (69.1%) for the second month when compared to the first month (68.03%).

Scores obtained for taste for T_3 gradually decreased from initial 84.23 per cent to 75.57 per cent in the third month. Among the Treatment means T_3 obtained the second position of 80.83 per cent after T_1 (81.83%).

The maximum total score for taste in T_4 was found to be in the first month (70.2%) and lowest score was for the initial period (58.67%). The second

month scored 61.77 per cent and the third month 62.67 per cent. The least treatment mean score was for T₄ (63.33%) when compared to other treatments.

Differences in the Treatment means was found to be significant as the values ranged between 81.83 per cent for T₁ and the least score of 63.33 per cent for T₄ treatment. Differences in the Period means was found to be non-significant.

Table 8f reveals the over all acceptability of milk chocolate by different groups of panel members.

Table 8f. Overall acceptability of milk chocolate by different groups of panel members

Criteria	Total mean score (%)			
	Technical experts	College students	School going students	Critical difference
Appearance	65.83	70.92	74.90	7.00 ^{NS}
Colour	70.92	74.33	73.54	4.80 ^{NS}
Flavour	71.25	74.88	69.40	6.28 ^{NS}
Texture	63.59	68.13	67.12	5.78 ^{NS}
Taste	67.54	75.79	76.66	6.36 ^{NS}
	67.83	72.81	72.30	

NS - Non significant

As revealed in the table, the overall acceptability of milk chocolate was maximum for panel members selected from college students (72.81%) followed by the scores obtained by the panel members selected from the school going children (72.30%). But there was no significant difference between the scores obtained by panel members with regard to each criteria.

Table 9a shows the acceptance of appearance of burfi for different storage periods.

Table 9a. Acceptability of appearance of burfi (Total mean score %)

Treatment	Period of storage in months				Treatment Mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	84.90	74.43	69.76	74.90	76.00
T ₂	59.10	60.00	64.20	64.90	62.10
T ₃	72.00	71.77	74.67	72.67	72.77
T ₄	63.33	65.30	61.53	64.20	63.59
Period mean	69.83	67.87	67.54	69.17	

1) CD for comparison of PM - 4.85^{NS}

2) CD for comparison of TM - 4.35**

3) CD for TM within period - 8.69^{NS}

** Significant at 1% level

NS - Non significant

Maximum score for the appearance of burfi was obtained during the initial period of T₁ (84.9%). On this treatment the least score obtained was for the second month (69.76%). For the first month there was a decrease in the scores obtained from the initial value (74.43%) but the acceptability for appearance increased during the third month (74.9%).

In T₂ there was a gradual increase in the acceptance of appearance. Initially the mean score was 59.1 per cent which increased to 64.9 per cent during the third month.

For T₃ the initial score of 72 per cent decreased to 71.77 per cent for the first month. Maximum score was obtained for the second month (74.67%) but for the third month it again decreased to 72.67 per cent.

The acceptability for T₄ was found to be high during the first month (65.3%) and least score was obtained during the second month (61.53%). The initial score for T₄ was 63.33 per cent.

Among treatments the highest mean score was for T₁ (76.00%) and least treatment mean score was for T₂ (62.1%). The difference between the treatment mean score was found to be statistically significant. There was no significant difference between period means.

Table 9b projects the acceptability of colour of burfi for different storage periods.

Table 9b. Acceptability of colour of burfi (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	77.8	74.1	71.57	72.87	74.08
T ₂	68.9	67.57	68.67	64.00	67.28
T ₃	74.43	66.67	75.57	73.8	72.61
T ₄	64.67	67.8	65.57	66.43	66.11
Period mean	71.45	69.03	70.34	69.28	

1) CD for comparison of PM - 2.86^{NS}

2) CD for comparison of TM - 4.172**

3) CD for TM within period - 8.34^{NS}

** Significant at 1% level

NS - Non significant

In T₁ maximum score for colour was for the initial period (77.8%) which decreased to 74.1 per cent during the first month. The scores obtained further decreased to 71.57 per cent during the second month but slightly higher score was obtained for the third month (72.87%).

In T₂ the scores obtained varied from 68.9 per cent to 64 per cent, the highest score being for the initial period and the least score for the third month.

In T₃ maximum total score was for the second month (75.57%) and least was for the first month (66.67%). But in T₄ maximum scores was for the first month (67.8%) followed by third month (66.43%).

When compared with other treatments T_1 scored the highest as Treatment mean (74.08%) whereas T_4 scored the least (66.11%). The difference in Treatment means were significant. The period means also varied from 71.45-69.03 per cent, the highest for the initial stage and the least for the first month but the difference observed in Period mean was not significant.

Table 9c shows the acceptability of flavour of burfi for different storage periods.

Table 9c. Acceptability of flavour of burfi (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	79.33	75.53	67.77	72.43	73.77
T ₂	66.67	62.9	63.57	60.47	63.4
T ₃	71.33	70.66	72.67	70.43	71.27
T ₄	61.8	65.13	64.43	61.1	63.12
Period mean	69.78	68.56	67.11	66.11	

1) CD for comparison of PM - 3.58^{NS}

2) CD for comparison of TM - 3.622**

3) CD for TM within period - 7.24^{NS}

** Significant at 1% level

NS - Non significant

As revealed in Table 9c, the maximum score for flavour of burfi was for the initial period (79.33%) and it decreased to 75.53 per cent during the first month, second month obtained the least score (67.77%).

For T_2 initial stage obtained the maximum score of 66.67 per cent and the least score for the third month (60.47%).

In T_3 maximum score was obtained for the second month (72.67%) and the least score for the third month (70.43%).



Plate 5. Organoleptic evaluation of cocoa products

In T₄ maximum score was for the first month (65.13%) and lowest score was for the third month (61.1%). when compared with other treatments, T₁ scored the highest (73.77%) followed by T₃ (71.27%), T₄ obtained the lowest Treatment mean (63.12%). Statistically the Treatment means were found to be significant. With regard to Period mean there was a gradual decline in the mean score obtained with period. The maximum being 69.78 per cent, during the initial period and the lowest (66.11%) for the third month but the difference in Period mean was not significant.

Table 9d projects the acceptability of texture of burfi for different storage periods.

Table 9d. Acceptability of texture of burfi (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	80.00	69.57	62.43	74.67	71.67
T ₂	58.00	60.00	55.97	65.53	59.87
T ₃	70.23	69.13	66.00	71.77	69.28
T ₄	57.97	56.23	55.57	64.67	58.61
Period mean	66.55	63.73	59.99	69.16	

1) CD for comparison of PM - 7.71^{NS}

2) CD for comparison of TM - 3.26**

3) CD for TM within period - 6.52^{NS}

** Significant at 1% level

NS- Non significant

As shown in the table the acceptability of texture for T₁ ranked highest in the initial period (80%) which gradually decreased to 62.43 per cent during the second month. By the third month the mean score increased to 74.67 per cent.

In T₂ maximum score (65.53%) was obtained for the third month followed by the first month (60%). Minimum score was for the second month (55.97%).

For T₃ third month ranked the highest score of 71.77 per cent. The least score was for the second month (66%). In T₄ also highest score was for the third month (64.67%). A total mean score of 57.97 per cent was obtained for the initial period which decreased during the first month (56.23%) and the second month (55.57%).

Treatment mean was found to be highest for T₁ (71.67) and lowest for T₄ (58.61%). Thus the differences in Treatment means were statistically significant. Period mean was highest for the third month (69.16%) and least Period mean for the second month (59.99%), but there was no significant difference in the period means.

Table 9e portrays the acceptability of taste of burfi for different storage periods.

Table 9e. Acceptability of taste of burfi (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	84.67	76.9	72.00	76.9	77.62
T ₂	62.90	60.87	57.97	64.67	61.60
T ₃	72.47	73.10	70.43	74.23	72.56
T ₄	53.53	61.57	63.57	63.13	60.45
Period mean	68.39	68.11	65.99	69.73	

1) CD for comparison of PM - 6.13^{NS}

2) CD for comparison of TM - 3.31**

3) CD for TM within period - 6.61**

** Significant at 1% level

NS- Non significant

In T₁ the acceptability of taste was found to rank highest for the initial period (84.67%) which decreased to 76.9 per cent during the first month. The scores further decreased to 72 per cent for the second month but again ranked 76.9 per cent for the third month.

For T₂ maximum and minimum scores ranged between 64.67-57.97 per cent for the third and second month respectively.

For T₃ also third month scored the highest (74.23%) and the second month scored the lowest (70.43%). But in T₄ maximum score for taste was for the second month (63.57%).

Significant differences were noticed between the Treatment means and Treatment means within periods. The Treatment mean varied between a maximum of 77.62 per cent in T₁ to a minimum of 60.45 per cent in T₄. However no significant difference was noticed for Period means.

Table 9f shows the overall acceptability of burfi by different panel members.

Table 9f. Overall acceptability of burfi by different groups of panel members

Criteria	Total mean score (Percentage)			Critical difference
	Technical experts	College students	School going students	
Appearance	64.67	70.33	70.81	4.19*
Colour	68.65	74.75	66.67	2.48**
Flavour	63.99	72.13	67.55	3.09**
Texture	60.67	67.16	66.74	6.66 ^{NS}
Taste	62.24	71.71	70.22	5.28*
Mean	64.04	71.22	68.39	

** Significant at 1% level

* Significant at 5% level

NS - Non significant

As indicated in the table, acceptability of burfi was maximum for panel members selected from college students (71.22%) and minimum for technical experts (64.04%). Significant differences were observed among different groups of panel members with regard to appearance, the school children scored the highest

Fig. 8. Acceptability of colour of burfi by different panel members

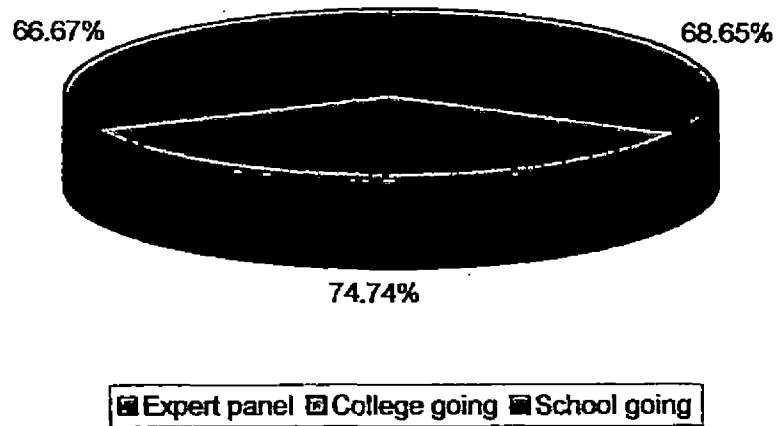
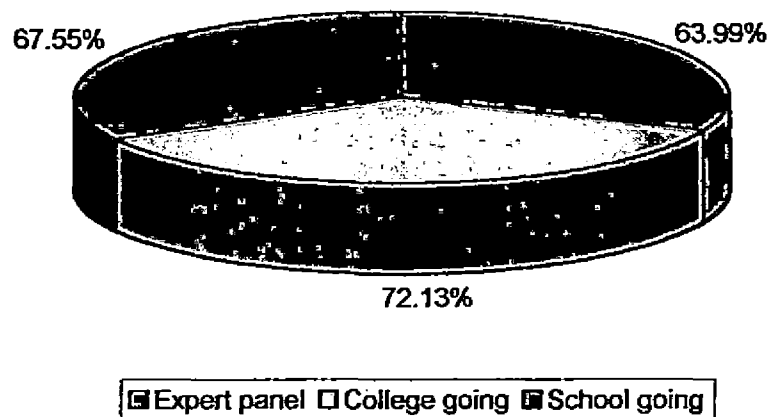


Fig. 9. Acceptability of flavour of burfi by different panel members



(70.81%) followed by college students (70.33%). Acceptability of colour by different panel members also showed significant difference as the score was maximum for college students (74.75%) and minimum for school going children (66.67%) (Fig. 8). Flavour also showed significant differences. With panel selected from college students ranked highest score of 72.13 per cent and technical experts ranked the lowest of 63.99 per cent (Fig. 9). Texture however did not show any significant difference. Taste also showed significant differences, the panel selected from college students scoring 71.71 per cent followed by school going children scoring 70.22 per cent and least by the technical experts scoring 62.24 per cent.

Table 10a presents the acceptability of appearance of fudge for different storage periods.

Table 10a. Acceptability of appearance of fudge (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	81.1	80.47	80.9	79.77	80.56
T ₂	56.77	68.63	70.63	68.9	66.23
T ₃	73.37	80.43	78.90	77.8	77.63
T ₄	69.87	71.10	66.67	62.00	66.66
Period mean	69.53	75.16	74.28	72.12	

1) CD for comparison of PM - 5.66^{NS}

2) CD for comparison of TM - 3.95**

3) CD for TM within period - 7.88^{NS}

** Significant at 1% level

NS- Non significant

Table 10a shows that for T₁ though scored a high mean score initially (81.1%) decreased by the third month to 79.77 per cent.

In T₂ the total mean score gradually increased from 56.77 per cent for the initial period to 70.63 per cent for the second month but decreased to 68.9 per

cent during the third month. In T_3 gradual increase in scores was observed up to first month (80.43%) which then gradually decreased to 77.8 per cent by third month. The same pattern was observed with T_4 with a maximum score of 71.1 per cent for the first month. Among treatments maximum treatment mean was for T_1 (80.56%) and the least Treatment mean was for T_2 (66.23%). The differences in the Treatment means were found to be statistically significant. Regarding Period mean maximum score was for the first month (75.16%) followed by the second month (74.28%). The Period mean for the initial stage was the least (69.53%) but differences in Period means were not statistically significant.

Table 10b reveals the acceptability of colour of fudge for different storage periods.

Table 10b. Acceptability of colour of fudge (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	84.67	82.00	81.77	79.13	81.89
T ₂	70.33	76.67	72.67	72.03	72.93
T ₃	79.33	80.47	83.8	75.57	79.79
T ₄	69.77	73.53	75.77	69.33	72.10
Period mean	76.03	78.17	78.5	74.02	

1) CD for comparison of PM - 3.29^{NS}

2) CD for comparison of TM - 3.48**

3) CD for TM within period - 6.95^{NS}

** Significant at 1% level

NS -Non significant

The table shows that the initial acceptability of T_1 (84.67%) gradually decreased by the third month to 79.13 per cent.

In T_2 the first month scored the highest (76.67%) and scores obtained decreased by the second and the third month (72.67 and 72.03 per cent respectively).

In T₃ maximum score for colour was for the second month (83.8%) and the lowest score was for the third month (75.57%). The same pattern was observed with T₄ also.

Significant difference was found between the treatment means as the values ranged between 81.89 per cent for T₁ and 72.10 per cent for T₄. No significant difference was found between the Period mean.

Table 10c shows the acceptability of flavour of fudge for different storage periods.

Table 10c. Acceptability of flavour of fudge (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	71.57	74.20	72.87	74.23	73.22
T ₂	60.47	71.03	67.57	66.67	66.43
T ₃	75.47	77.80	73.97	76.00	75.81
T ₄	65.1	71.10	72.20	62.23	67.66
Period mean	68.15	73.53	71.65	69.78	

1) CD for comparison of PM - 4.69^{NS}

2) CD for comparison of TM - 2.64**

3) CD for TM within period - 5.27*

** Significant at 1% level

* Significant at 5% level

NS - Non significant

As revealed in the table the acceptability of flavour for T₁ increased to 74.23 per cent by the third month from 71.57 per cent of total mean score for the initial period.

The highest total score obtained for T₂ was 71.03 per cent for the first month and the least score was for the initial period (60.47%). After first month the scores were found to be decreasing.

First month scored the highest in T₃ (77.8%) which decreased to a minimum score of 73.97 per cent by the second month.

In T₄ the second and the first month scored the highest (72.2% and 71.1% respectively). The third month scored the least (62.23%). There observed a significant difference in Treatment means and Treatment means within periods. No significant difference was observed in Period means.

Table 10d shows the acceptability of texture of fudge for different storage periods.

Table 10d. Acceptability of texture of fudge (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	61.77	72.23	73.13	68.23	68.84
T ₂	44.23	62.63	65.33	60.90	58.27
T ₃	65.80	72.00	72.47	71.80	70.52
T ₄	58.00	63.13	67.77	58.00	61.73
Period mean	57.45	67.50	69.67	64.73	

1) CD for comparison of PM - 6.61*

2) CD for comparison of TM - 4.35**

3) CD for TM within period - 8.69^{NS}

** Significant at 1% level

* Significant at 5% level

NS - Non significant

As seen in the table acceptability of the texture of T₁ of fudge was found to be maximum during the second month (73.13%) and minimum for the initial period (61.77%). A gradual increase in the score was observed in T₂ upto second month (65.33%) which decreased to 60.9 per cent during the third month.

T₃ scored the highest treatment mean (70.52%). The maximum being for the second month (72.47%).

In T_4 acceptability gradually increased upto second month a mean score of 67.77 per cent but then it decreased to the initial score of 58 per cent by the third month.

Differences in the Period means were found to be significant, the value ranged from 57.45 per cent initially and 69.67 per cent in second month. Differences in the Treatment means were also found to be significant, T_3 scoring the highest (70.52%).

Table 10e represents the acceptability of taste of fudge for different storage periods.

Table 10e. Acceptability of taste of fudge (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	76.43	80.67	78.47	75.80	77.84
T ₂	52.00	70.73	71.33	70.47	66.13
T ₃	77.80	80.00	80.20	77.80	78.94
T ₄	63.10	73.13	71.53	70.00	69.44
Period mean	67.33	76.13	75.13	73.51	

1) CD for comparison of PM - 3.1**

2) CD for comparison of TM - 3.39**

3) CD for TM within period - 7.0^{NS}

** Significant at 1% level

NS- Non significant

As represented in the table, regarding taste of the fudge, T_1 had higher acceptability during first month (80.67%) which decreased to a minimum score of 75.8 per cent by the third month.

In T_2 , increase in the acceptability was observed till second month (71.33%) which then decreased to 70.47% for the third month. But the initial score was only 52 per cent.

In T₃ also maximum score was obtained for the second month (80.2%) but minimum score was for the initial as well as for the third month (77.8 per cent).

The acceptability of T₄ increased to 73.13 per cent by the first month from the initial score of 63.1 per cent.

Among treatments T₃ had highest Treatment mean (78.94%) whereas T₂ had lowest Treatment mean (66.13%) and the difference observed in treatments were found to be statistically significant. Maximum period mean was for the first month (76.13%) and minimum for the initial month (67.33%). The differences in the Period mean was also found to be significant. There was no significant variation of Treatment mean within period.

Table 10f represents the overall acceptability of fudge by different groups of panel members.

Table 10f. Overall acceptability of fudge by different groups of panel members (Total mean score %)

Criteria	Total mean score (Percentage)			
	Technical experts	College students	School going students	Critical difference
Appearance	74.92	74.63	71.76	4.90 ^{NS}
Colour	78.59	80.22	71.23	2.85**
Flavour	69.81	74.59	67.94	4.06*
Texture	62.93	65.54	66.04	5.72 ^{NS}
Taste	72.41	74.59	72.26	2.66 ^{NS}
Mean	71.70	73.90	69.85	

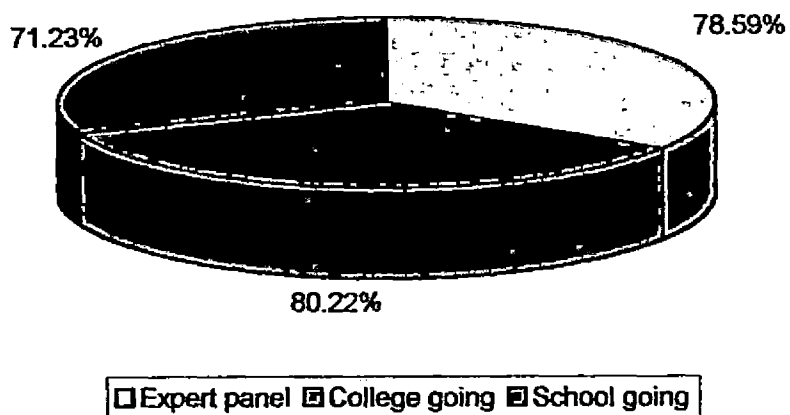
** Significant at 1% level

* Significant at 5% level

NS-Non significant

As shown in the table, acceptability of fudge was maximum for members selected from college students (73.90) and minimum for members

Fig. 10. Acceptability of colour of fudge by different panel members



selected from school going children (69.85%). With regard to the appearance, texture and taste of the fudge there was no significant difference in the scores obtained by different panel members. But there observed a significant difference in the scores obtained for colour and flavour by different groups of panel members (Fig. 10).

Table 11a represents the acceptability of appearance of biscuit for different storage periods.

Table 11a. Acceptability of appearance of biscuit (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	71.77	75.13	67.77	60.90	68.89
T ₂	67.77	67.67	64.47	56.43	64.08
T ₃	70.90	70.00	65.77	63.10	67.44
T ₄	64.87	67.23	60.00	53.33	61.36
Period mean	68.83	70.00	64.50	58.44	

1) CD for comparison of PM - 8.29^{NS}

2) CD for comparison of TM - 3.11^{**}

3) CD for TM within period - 6.23^{NS}

** Significant at 1% level

NS - Non significant

As shown in the table in T₁, the acceptability of the appearance of biscuit was high for the first month (75.13%) which decreased to a minimum of 60.9 per cent by the third month.

In T₂ the acceptability was found to be decreasing from the initial stage (67.77%) to a minimum by the third month (56.43%). A same trend was observed in T₃ also.

In T₄ maximum score was obtained for the first month (67.23%) and the least score was for the third month (53.33%). There observed a significant difference in the variations observed with the treatments, T₁ with the maximum Treatment mean (68.89%) and T₄ with the lowest Treatment mean (61.36%). Maximum Period mean was observed for the first month (70%). But there was no significant difference with regard to period mean.

Table 11b represents the acceptability of colour of biscuit for different storage periods.

Table 11b. Acceptability of colour of biscuit (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	69.57	74.00	65.77	59.57	67.23
T ₂	66.43	60.43	63.33	54.90	61.28
T ₃	67.37	69.80	65.33	64.00	66.63
T ₄	57.43	61.33	60.67	53.80	58.31
Period mean	65.2	66.39	63.77	58.07	

1) CD for comparison of PM - 7.94^{NS}

2) CD for comparison of TM - 3.02**

3) CD for TM within period - 6.04^{NS}

** Significant at 1% level

NS - Non significant

As shown in the table acceptability of the colour of biscuit of T₁ was highest for the first month (74%). Initially it scored 69.57 per cent which decreased to 59.57 per cent by the third month.

In T₂ acceptability of colour decreased to 54.9 per cent by the third month from the initial score of 66.43 per cent.

In T₃ first month scored the highest score (69.8%) which decreased to 64 per cent during the third month. The acceptability of T₄ was maximum during the first month (61.33%) which decreased to 53.8 per cent during the third month.

When compared with other treatments, T₁ scored the highest Treatment mean (67.23%) followed by T₃ (66.63%). The least treatment mean was for T₄ and the differences in treatment mean was found to be significant. Regarding period mean maximum was for the first month (66.39%) and the minimum for the third month (58.07%) and the differences in the period mean were not significant.

Table 11c gives the picture of acceptability of flavour of biscuit for different storage periods.

Table 11c. Acceptability of flavour of biscuit (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	63.57	66.00	67.80	62.63	65.00
T ₂	58.67	59.77	62.67	57.77	59.72
T ₃	61.77	67.10	66.63	59.53	63.76
T ₄	54.43	59.13	61.33	51.10	56.50
Period mean	59.61	63.00	64.61	57.76	

1) CD for comparison of PM - 7.94^{NS}

2) CD for comparison of TM - 2.68**

3) CD for TM within period - 5.37^{NS}

** Significant at 1% level

NS - Non significant

Second month scored the highest mean score of 67.8 per cent for T₁ followed by the first month (66%). Third month scored the lowest mean score of 62.63 per cent. In T₂ also there was a gradual increase in the total mean score from the initial score of 58.67 per cent to 62.67 per cent in the second month but then decreased to 57.77 per cent for the third month.

For T₃ the gradual increase in mean scores was only upto first month (67.1%) then decreased to a minimum of 59.53 per cent in the third month.

T₄ also revealed the same score pattern as that of T₂. Treatment mean score was highest for T₁ (65%) and lowest for T₄ (56.5%) and the differences observed in Treatment means were found to be significant. But no differences were observed between period means.

Table 11d reveals the acceptability of texture of biscuits for different storage periods.

Table 11d. Acceptability of texture of biscuit (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	69.33	70.43	72.43	62.90	68.78
T ₂	64.20	61.57	66.20	56.87	62.21
T ₃	66.67	69.10	66.87	65.13	66.94
T ₄	59.57	63.53	61.53	48.67	58.33
Period mean	64.94	66.16	66.76	58.39	

1) CD for comparison of PM - 6.25^{NS}

2) CD for comparison of TM - 3.15**

3) CD for TM within period - 6.31^{NS}

** Significant at 1% level

NS - Non significant

The total mean score for T₁ at initial month was 69.33 per cent which decreased to 62.9 per cent by the third month. Second month scored the highest mean score (72.43%) for texture.

In T₂ second month scored the highest (66.20%) and the least score was for by the third month (56.87%)

In T₃ the first month obtained the highest mean score of 69.1 per cent and the third month got the least mean score of 65.13 per cent.

In T₄ also the first month scored the highest mean score of 63.53 per cent and the minimum score was for the third month (48.67%).

When compared to other treatments T₄ had the lowest treatment mean of 58.33 per cent and the highest treatment mean was for the T₁ first month (68.78%). A significant difference was observed between the Treatment means. Period mean varied between 66.76 to 58.39 per cent but the differences observed were not statistically significant.

Table 11e projects the acceptability of taste of biscuit for different storage periods.

Table 11e. Acceptability of taste of biscuit (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	65.33	72.20	69.10	62.23	67.22
T ₂	46.00	58.67	61.10	53.30	54.77
T ₃	65.53	67.53	67.57	63.77	66.10
T ₄	43.97	55.77	59.10	48.20	51.76
Period mean	55.21	63.54	69.22	56.88	

1) CD for comparison of PM - 3.86*

2) CD for comparison of TM - 3.55**

3) CD for TM within period - 7.09^{NS}

** Significant at 1% level

* Significant at 5% level

NS- Non significant

As revealed in the table the acceptability of the taste of biscuit for T₁ was maximum during the first month with a total mean score of 72.2 per cent. Minimum score was for the third month (62.23%).

In T₂ initial score was found to be the least (46%) followed by the scores obtained for the third month (53.3%). Maximum score was for the second month (61.1%).

In T₃ the acceptability of taste gradually increased upto second month (67.57%) which decreased to 63.77 per cent for the third month.

In T₄, the initial total mean score of 43.97 per cent increased to 59.1 per cent by second month and then decreased to 48.2 per cent by third month.

Among treatments T₁ scored the highest Treatment mean of 67.22 per cent followed by T₃ (66.1%). The least Treatment mean was for T₄ (51.76%) and differences in Treatment means observed were found to be significant. Among the storage periods maximum acceptability was during the second month with a period mean of 69.22 per cent. The least acceptability was for the initial period with a period mean of 55.21 per cent. The difference in period means were found to be statistically significant.

Table 11f displays the overall acceptability of biscuit by different groups of panel members.

Table 11f. Overall acceptability of biscuit by different groups of panel members

Criteria	Total mean score (Percentage)			
	Technical experts	College students	School going students	Critical difference
Appearance	66.56	69.92	59.85	7.18 ^{NS}
Colour	63.77	68.21	58.09	6.86 ^{NS}
Flavour	62.25	64.57	56.91	6.89 ^{NS}
Texture	62.67	68.83	60.69	5.40*
Taste	60.25	63.28	56.36	3.88*
Mean	63.1	66.96	58.38	

NS - Non significant
 * Significant at 5% level

As displayed in the table, the overall acceptability of biscuit was maximum for the panel selected from the college students (66.96%) and least for

the panel selected from school going children (58.38%). The differences in the scores obtained by panel members with regard to criterias like appearance, colour and flavour was not statistically significant, but the scores obtained for texture and taste showed some significant difference between different groups of panel member. For texture and taste the college students group ranked the highest (68.83 and 63.28 per cent respectively).

Table 12a reveals the acceptability of appearance of ice cream prepared from cocoa mass for different storage periods.

Table 12a. Acceptability of appearance of ice cream (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	78.67	83.77	77.77	72.67	78.22
T ₂	72.90	70.70	72.00	68.20	70.95
T ₃	72.20	76.23	71.33	74.47	73.56
T ₄	68.43	71.57	70.20	72.03	70.56
Period mean	73.05	75.57	72.83	71.84	

1) CD for comparison of PM - 3.77^{NS}

2) CD for comparison of TM - 2.93**

3) CD for TM within period - 5.85^{NS}

** - Significant at 1% level

NS - Non significant

As seen in the table maximum score for appearance of ice cream among T₁ was for the first month (83.77%). The scores obtained was found to be decreasing to a minimum mean score of 72.67 per cent for the third month. The initial score obtained was 78.67 per cent.

In T₂ the initial score of 72.9 per cent which was the maximum decreased to a minimum of 68.2 per cent for the third month.

In T₃ maximum score was for the first month (76.23%) and the least score for the second month (71.33%).

In T₄ maximum mean score was obtained by the third month (72.03%).

The Treatment means varied from 78.22 per cent for the T₁ to 70.56 per cent for the T₄ and the differences observed was found to be significant. Maximum Period mean was for the first month (75.57%) and least was for the third month (71.84%), but the differences were not significant.

Table 12b displays the acceptability of colour of ice cream prepared from cocoa mass stored for different periods.

Table 12b. Acceptability of colour of ice cream (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	76.47	76.46	76.00	72.43	75.33
T ₂	73.10	68.20	75.33	68.47	71.27
T ₃	74.67	74.87	70.90	75.13	73.89
T ₄	69.57	70.00	71.53	70.23	70.33
Period mean	73.45	72.38	73.44	71.57	

1) CD for comparison of PM - 3.39^{NS}

2) CD for comparison of TM - 3.669*

3) CD for TM within period - 7.34^{NS}

NS - Non significant

* Significant at 5% level

As seen in the table the acceptability of colour decreased in T₁ from 76.47 per cent initially to 72.43 per cent for the third month. The treatment mean score was maximum at 75.33 per cent.

In T₂ the initial mean score of 73.1 per cent decreased to 68.2 per cent by the first month but again increased to 75.33 per cent for the second month.



The acceptability of colour in T_3 was found to be maximum for the third month (75.13%).

In T_4 maximum score was for the second month (71.53%) and minimum score was for the initial period (69.57%). The Treatment means varied between 75.33 per cent for the T_1 to 70.33 per cent for the T_4 and the difference was found to be significant, but there was no significant difference with regard to period mean.

Table 12c shows the acceptability of flavour of ice cream prepared from cocoa mass stored for different storage periods.

Table 12c. Acceptability of flavour of ice cream (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	73.10	76.00	74.70	67.33	72.78
T ₂	61.13	69.30	72.67	63.30	66.61
T ₃	69.10	74.43	70.87	74.23	72.16
T ₄	62.23	68.23	66.00	65.57	65.51
Period mean	66.39	72.00	71.06	67.61	

1) CD for comparison of PM -4.49^{NS}

2) CD for comparison of TM - 3.15**

3) CD for TM within period -6.31^{NS}

** - Significant at 1% level

NS - Non significant

The acceptability of flavour of ice cream in T_1 was maximum during the first month with a total mean score of 76 per cent. Minimum score was for the third month (67.33%).

In T_2 the acceptability gradually increased from the initial mean score of 61.13 per cent to 72.67 per cent till the second month and for the third month the mean score decreased to 63.3 per cent.

In T₃ the total mean score varied between 69.1 per cent during the initial period to 74.43 per cent for the first month.

In T₄ also maximum score was for the first month (68.23%) and least score for the initial period (62.23%). Among treatments T₁ was found to score maximum Treatment mean score (72.78%) whereas T₄ scored the minimum (65.51%). The differences in treatment mean was found to be significant but there was no significant variation in acceptability with storage period of cocoa mass.

Table 12d shows the acceptability of texture of ice cream prepared from cocoa mass stored for different storage periods.

Table 12d. Acceptability of texture of ice cream (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	70.63	75.80	71.77	70.23	72.11
T ₂	65.10	68.90	69.10	62.90	66.50
T ₃	69.77	75.77	68.17	70.57	71.07
T ₄	65.10	69.13	67.77	64.67	66.67
Period mean	67.65	72.40	69.20	67.09	

1) CD for comparison of PM - 4.12^{NS}

2) CD for comparison of TM - 3.64^{**}

3) CD for TM within period - 7.29^{NS}

** - Significant at 1% level

NS - Non significant

As seen in the table, in T₁ the first month had the highest total mean score of 75.8 per cent with regard to the texture of ice cream. The third month obtained the least score of 70.23 per cent.

A steady increase in the acceptability was seen up to second month (69.1%) for T₂.

In T₃ maximum score was for the first month (75.77%) and the minimum score was for the second month (68.17%).

In T₄ maximum mean score was for the first month (69.13%) and the least score was 64.67 per cent for the third month. There was significant differences observed in Treatment means but not in period means.

Table 12e presents the acceptability of taste of ice cream prepared from cocoa mass stored for different storage periods.

Table 12e. Acceptability of taste of ice cream (Total mean score %)

Treatment	Period of storage in months				Treatment mean
	P ₀	P ₁	P ₂	P ₃	
T ₁	71.63	77.33	79.10	70.90	74.74
T ₂	59.77	65.10	73.13	59.53	64.38
T ₃	74.87	76.67	74.00	77.37	75.73
T ₄	65.33	64.90	67.33	66.70	66.07
Period mean	67.90	71.00	73.39	68.63	

1) CD for comparison of PM - 0.96 **

2) CD for comparison of TM - 3.70**

3) CD for TM within period - 7.3^{NS}

** - Significant at 1% level

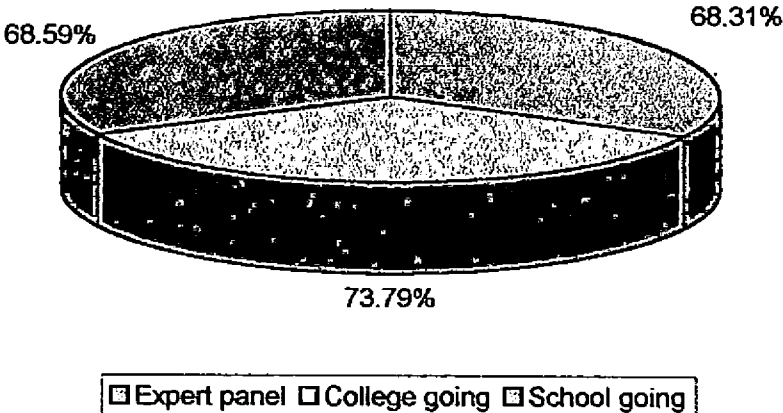
NS - Non significant

There was a steady increase in acceptability of taste of ice cream up to second month (79.1%) in T₁. Initial and first month scored 71.63 per cent and 77.33 per cent respectively. But the acceptability of taste reduced to 70.9 per cent by third month. The same scoring pattern was observed in T₂ also.

In T₃ maximum mean score was for the third month (77.37%) and the least score was for the second month (74%).

In T₄, a fluctuating scoring pattern was noted with a total mean score of 65.33 per cent initially, 64.9 per cent during first month, 67.33 per cent and 66.7 per cent during the second and the third months respectively.

Fig. 11. Acceptability of taste of icecream by different panel members



Among treatments, the taste of ice cream was found to be more acceptable for T₃ (75.73%) followed by T₁ (74.74%). T₂ was found to be the least acceptable as revealed by the Treatment means score of 64.38 per cent. The differences in treatment mean was found to be significant. The acceptability of taste of ice cream varied with period of storage and the difference in Period means observed was also significant. The second month scored highest (73.39%) and the third month scored the least (68.63%).

Table 12f. Overall acceptability of ice cream by different groups of panel members.

Table 12f. Overall acceptability of ice cream by different groups of panel members

Criteria	Total mean score (Percentage)			Critical difference
	Technical experts	College students	School going students	
Appearance	71.58	75.71	72.61	3.27 ^{NS}
Colour	72.49	75.46	70.17	2.94*
Flavour	66.58	73.31	67.91	3.90*
Texture	69.05	72.62	65.59	3.56*
Taste	68.31	73.79	68.59	0.83**
Mean	69.60	74.18	68.97	

** Significant at 1% level

* Significant at 5% level

NS - Non significant

It is revealed from the table that the acceptability of ice cream was highest for the panel members selected from college students (74.18%) followed by the members of technical experts (69.60%) and least by the school children (68.97%). The scores obtained by different groups of panel members for criterias like colour, flavour, texture and taste were found to have significant difference while the scores obtained for appearance have no significant difference (Fig. 11).

Discussion

5. DISCUSSION

The discussion pertaining to the study is explained under the following headings.

5.1 Keeping quality of cocoa mass

Free flowness of the cocoa mass

It was observed that the powdered cocoa mass was free flowing initially and gradually clumped by the third month. This may be due to the presence of cocoa butter in cocoa mass. According to Catesberg and Dommelen (1990) cocoa powder can become lumpy as a result of moist storage. Colour change was also noticeable. It became pale brown in colour by the third month.

Solubility of cocoa mass

The solubility of cocoa mass prepared by both 5 minutes roasting and 10 minutes roasting of cocoa beans was not satisfactory in warm water. As indicated by Mossu (1992) cocoa powder is not normally soluble in water and will float on the surface. This insoluble nature of cocoa mass may be due to its high content of cocoa butter which is soluble only in ether.

Microbial count

In the present study the initial fungal load for cocoa mass prepared by 5 minutes roasting was 2 cfu/g which gradually increased to 7.5 cfu/g by the third month. The cocoa mass prepared by 10 minutes roasting showed a decrease in fungal load when compared to 5 minutes roasting, may be because of the heat processing of roasting which may retard mould growth. The fungal load of cocoa

mass prepared by 10 minutes roasting was 1.5 cfu/g which increased to 4 cfu/g during the third month.

The initial bacterial load for cocoa mass prepared by 5 minutes roasting was found to be 7.5 cfu/g, which increased gradually to 26 cfu/g by the third month. The tendency of formation of bacterial colonies in cocoa mass prepared by 10 minutes roasting was found to be low. According to Wood and Lass (1985) *Escherichia coli*, *Salmonella* and *Shigella* will be killed during the normal roasting of the beans. Thus it was seen that initially for 10 minutes roasting it had 4 cfu/g which increased to 23 cfu/g by third month. According to Swaminathan (1987) the maximum limit of bacterial count in infant foods is 50,000 count/g. Hence, the observed bacterial count in cocoa mass during storage can be considered to be within the safe level. The initial microbial load in cocoa mass may be due to the use of beans from diseased pods, the activity of moulds inside the beans due to incomplete or delayed drying or due to prolonged storage under humid conditions (The cocoa, chocolate and confections Alliance, 1984).

Peroxide value

The mean peroxide value for cocoa mass prepared by 5 minutes roasting was 1.1 m.eq/kg and even low for 10 minutes roasting (0.7 m.eq/kg) initially. There was a gradual increase in the peroxide value up to 2 m.eq/kg and 1.4 m eq./kg for 5 minutes and 10 minutes roasting respectively by the end of third month. As stated by David and Wen (1983) peroxide value is not always a reliable indication of the degree of oil oxidation because the highly oxidized oil may have

low peroxide value if the peroxides formed have been decomposed. According to Fennema (1985) various attempts have been made to correlate peroxide values with the development of rancid flavour. Good correlations were sometimes obtained, but very often the results were inconsistent. In the present study also the cocoa mass did not develop any detectable rancid flavour on storage even though there was an increase in the peroxide value.

5.2 Organoleptic evaluation of products made with cocoa mass at monthly intervals

Acceptability of the appearance of milk chocolate prepared by incorporating cocoa mass at 5 per cent level was found to be high when compared to incorporation at 10 per cent level during all the storage periods. Acceptability was high for chocolate made with cocoa mass stored for two months and roasted for 5 minutes (84%) and for cocoa mass made by 10 minutes roasting the acceptability was high for the first month (82.43%). With regard to the acceptability of appearance the best treatment was cocoa mass with 5 minutes roasting incorporating at 5 per cent level (80.95%). The least acceptable chocolate with respect to appearance was with cocoa mass prepared by 10 minutes roasting and incorporated at 10 per cent level (59.88%). The acceptability of appearance was found to be decreasing with increased storage period but the difference were not significant.

The observed low acceptability of milk chocolate with increased concentration of cocoa mass can be attributed to the consistency of the chocolate with 10 per cent level. With 10 per cent level the chocolates made were sticky and

cannot be molded. According to Gonze and Schueren (1997) it is possible to produce good quality chocolates, with decrease in the content of cocoa bitter together with the use of defected cocoa powder.

The acceptability of the colour of chocolate was also found to be high at 5 per cent level incorporation of cocoa mass. Maximum acceptability of the chocolate was with cocoa mass prepared by 10 minutes roasting and that too with a maximum score of 81.30 per cent for the first month. With cocoa mass of 5 minutes roasting maximum acceptability was observed during the second month (78.67%). With regard to the acceptance of colour 10 minutes roasting at 5 per cent level was found to be ideal (77.84%). The least acceptance was for the chocolate with cocoa mass of 5 minutes roasting and 10 per cent level incorporation (68.72%). The acceptability of colour also changed with storage period, maximum acceptance was for the product made with one month storage (75.39%). But the differences were not significant with storage period. At 10 per cent level all the products were dark in colour, may be due to the high cocoa butter content of cocoa mass.

The flavour of chocolate was also highly acceptable at 5 per cent level incorporation. And for 5 minutes and 10 minutes roasting maximum acceptability for flavour was recorded for the first month (78.90 and 82% respectively). With regard to flavour the highly acceptable treatment was 5 minutes roasting, 5 per cent level incorporation, the least acceptable product was with 10 minutes roasting 10 per cent level incorporation. For all the treatments maximum score for flavour was

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obtained for the first month and the least score for the third month, but the difference in Period mean were not significant. According to Hasim and Selamat (1997), pyrazines are significant contributors to the flavour of roasted cocoa and there is no deterioration of flavour seen during the three month of storage study.

Texture of milk chocolate also showed significant differences with regard to various treatments. Here also the acceptability was high for 5 per cent level incorporation. Maximum treatment mean was for 5 minutes roasting (75.62%) followed by 10 minutes roasting (75.28%). With storage period, maximum Period mean was for the first month (68.27%) but the differences in the scores obtained due to storage period was not significant. Here again the concentration of cocoa mass is an important factor which determines the texture of the product rather than the storage period. As observed the Treatment means were low in both T₂ and T₄ treatments (56.72 and 57.49% respectively). Thus chocolates prepared from 10 per cent level incorporation were found to be very sticky and thus cannot be molded into shapes. This may be due to the high cocoa butter content in cocoa mass. According to Wright (1999) cocoa butter is a solid substance at ordinary temperature but softens at 25°C.

Overall acceptability of milk chocolate was found to be maximum among college going students (72.81%) followed by school going children (72.30%). But there was no significant difference between the scores obtained by different groups of panel members with regard to each criteria.

In Burfi the acceptability of appearance was high for products made with cocoa mass incorporated at 5 per cent level. Maximum acceptability for

appearance was found to be for burfi made by incorporating cocoa mass made by 5 minutes roasting with a Treatment mean of 76 per cent followed by burfi made with cocoa mass of 10 minutes roasting (72.77%). The differences in the treatment means were found to be significant. With storage period maximum acceptability was for the initial period for all treatments with a Period mean of 69.83 per cent but there was no significant difference between the Period means.

Regarding the colour of burfi, acceptability was high for products made with cocoa mass incorporated at 5 per cent level. Maximum acceptability for colour was observed for burfi made with cocoa mass of 5 minutes roasting with a treatment mean of 74.08 per cent. The least acceptable products were burfies made with cocoa mass of 10 minutes roasting and incorporated at 10 per cent level with a treatment mean of 66.11 per cent. A significant difference in the treatment means were observed. The low acceptability of the products at 10 per cent level incorporations may be due to the dark colour of cocoa mass at higher concentration. For all the treatments maximum acceptability was found to be for the initial period, with a Period mean of 71.45 per cent, which decreased to 69.28 per cent by the third month. But the difference in Period means were not significant. This indicated that there was not much change with the acceptability of the colour of the products due to storage period.

Here again burfies with high acceptability for flavour was for the products with cocoa mass of 5 per cent level incorporation. Regarding roasting time 5 mts roasting was found to be ideal for maximum flavour of burfi, with a

treatment mean of 73.77 per cent. Acceptability of flavour was least for burfies made by incorporating cocoa mass prepared by 10 minutes roasting and incorporated at 10 per cent level with a treatment mean of 63.12 per cent. The differences in the treatment means were found to be significant. All the products showed maximum acceptability of flavour initially (69.78%) which gradually decreased to 66.11 per cent by the third month but the differences were not significant.

Burfies with more acceptable texture was found to be in products with 5 per cent level incorporation of cocoa mass. Highly acceptable texture was obtained for burfies made with cocoa mass of 5 minutes roasting with a treatment mean of 71.67 per cent followed by burfies made with cocoa mass of 10 minutes roasting (69.28%). But with storage period in all treatments except T₁ the acceptability of texture was found to be increased when compared to the initial scores. But the differences in the Period means indicated no statistical significance.

More acceptable taste was observed in burfies made with cocoa mass incorporated at 5 per cent level. Maximum taste was for burfies with cocoa mass made by 5 minutes roasting with a treatment mean of 77.62 per cent. The least acceptable treatment with regard to taste was cocoa mass made by 10 mts roasting and incorporated at 10 per cent level, with a treatment mean of 60.45 per cent. The differences in the taste of the products with regard to treatments were found to be significant. The decrease in the acceptability of taste in the products with higher concentration of cocoa mass is due to the bitterness developed in the products.

There was no significant difference in the taste of the products due to storage period of the cocoa mass.

The overall acceptability of burfi was found to be maximum among College going students (71.22%) and the expert panel showed the least acceptability (64.04%). There observed significant differences between the scores obtained by different groups of panel members with regard to appearance, colour, flavour and taste of burfies, but there was no significant difference in the scores obtained for texture.

Appearance of fudge was more acceptable for products made with cocoa mass incorporated at 5 per cent level. Acceptability of appearance was maximum for fudge with cocoa mass roasted for 5 minutes with a Treatment mean of 80.56 per cent followed by cocoa mass roasted for 10 minutes (77.63%) incorporated at 10 per cent level. There was significant difference in the acceptability of appearance with regard to treatments. The high concentration of cocoa mass at 10 per cent level made the fudge in T₂ and T₄ treatments relatively soft and sticky and hence its low acceptability for appearance. The storage period of cocoa mass did not show any significant difference in the acceptability of the appearance of the products.

Colour of the fudge was highly acceptable at 5 per cent incorporation level. Maximum acceptability for colour was for the fudge with cocoa mass roasted for 5 minutes, with Treatment mean 81.89 per cent. There was significant difference in the acceptability of colour with regard to treatments. From the above

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observations it was noted that the acceptability of the colour of the products in 5 minutes roasting gradually decreased while the acceptability gradually increased upto second month for 10 minutes roasting. There was no significant difference in the acceptability of products made with cocoa mass stored for three months.

Flavour of the fudge was also high at 5 per cent level incorporation. However maximum acceptability for flavour was for fudge with cocoa mass roasted for 10 minutes with Treatment means 75.81 per cent. The least acceptable product with regard to flavour was for the fudge prepared by cocoa mass made by roasting for 5 mts and incorporating at 10 per cent level (66.43%). Thus here flavour of the fudge was influenced by the time of roasting of cocoa beans. There was significant difference in the Treatment mean. Maximum acceptability for flavour was obtained for fudge prepared by cocoa mass stored for one month with a period mean of 73.53 per cent but there was no significant differences in the Period means.

Texture of fudge was also found to be more acceptable with cocoa mass at 5 per cent level incorporation. Regarding roasting time 10 minutes roasting was found to be more acceptable with a Treatment mean of 70.52 per cent. Acceptability of the texture of fudge was found to be highest with the cocoa mass stored for 2 months with a Period mean of 69.67 per cent. There observed a gradual increase in the acceptability of texture with storage upto the second month. The differences in the Period means observed were found to be significant.

Taste was also found to be more acceptable with cocoa mass incorporated at 5 per cent level. Here also the most tasteful products were the

fudge prepared with cocoa mass of 10 minutes roasting with a treatment means of 78.94 per cent followed by cocoa mass of 5 minutes roasting (77.84%). Hence level of incorporation of cocoa mass and roasting time had a significant influence on the taste of the product. Taste was also found to vary with the period of storage of cocoa mass. Maximum acceptability of taste was observed with products made with cocoa mass stored for one month with a period mean of 76.13 per cent. A significant difference in the taste of fudge was observed with cocoa mass stored for different periods. Flavour and taste of fudge was found to be increasing with cocoa mass stored for one month indicating no rancidity developed in cocoa mass. Gwinn (1992) has reported that cocoa mass contained antioxidants that discourage rancidity and allowed storage life of 2-5 years.

Here again the over all acceptability of the fudge was found to be more among college going students with a total mean score of 73.9 per cent followed by the expert panel (71.70%). Significant differences were observed between the scores obtained by different groups of panel members with regard to colour and flavour of the products.

Biscuits made with cocoa mass incorporated at 5 per cent level was found to be more acceptable. But with the time of roasting 5 minutes had the highest score for acceptability of appearance with a Treatment mean of 68.89 per cent followed by 10 minutes roasting (67.44%). There was significant difference in the Treatment means. Acceptability of the appearance of biscuits was maximum with the products made with cocoa mass stored for one month (70%). By the end

of third month the acceptability was found to be decreasing but there was no significant difference in the acceptability of appearance due to storage period of cocoa mass.

Colour was also found to be acceptable at 5 per cent level incorporation of cocoa mass. Cocoa mass prepared by 5 minutes roasting was found to be ideal for the colour of biscuits with the highest Treatment mean of 67.23 per cent. Biscuits prepared with cocoa mass roasted for 10 minutes and at 10 per cent level of incorporation scored the least Treatment mean (58.31%). The increased concentration of cocoa mass and also increased time of roasting resulted in very dark coloured biscuits. There was significant difference in the acceptability of the colour of biscuits due to various treatments.

Maximum acceptability of the colour of biscuits was found for biscuits with cocoa mass stored for one month (66.39%) which decreased to a minimum by the end of third month (58.07%). But differences in the Period means were not significant indicating that storage period of cocoa mass has no significant influence on the colour of biscuits.

Flavour was also maximum for biscuits with cocoa mass at 5 per cent level incorporation. Five minutes roasting developed the maximum flavour with a Treatment mean of 65 per cent followed by 10 minutes roasting (63.76%). Least acceptable products with regard to flavour was with cocoa mass roasted for 10 minutes at 10 per cent level incorporation. The differences in the acceptability of flavour with respect to level of incorporation and time of roasting was found to be

significant. With respect to storage time of cocoa mass maximum acceptability was found in biscuits with cocoa mass stored for 2 months (64.61%) but the differences observed was not significant.

The acceptability of the texture and taste of biscuits also showed the same pattern the most acceptable products with cocoa mass at 5 per cent level incorporation, 5 minutes roasting ranking first and 10 minutes roasting ranking the second. But one difference observed was the significant differences in the taste of the biscuit with cocoa mass stored for different periods. Acceptability of taste was maximum for biscuits with cocoa mass stand for 2 month (69.22%). In fudge also the taste was found to be significantly high with cocoa mass stored for one month.

The over all acceptability of biscuits was found to be more among college students with a total mean score of 66.96 per cent. Biscuits were least acceptable for school children (58.38%). Significant differences were observed with taste and texture of biscuit among different groups of panel number.

Chocolate ice cream is one of the most widely accepted dairy products. Appearance of the ice creams with cocoa mass was highly acceptable at 5 per cent level incorporation. 5 minutes roasting ranking the first (78.22%) followed by 10 minutes roasting (73.56%). Significant differences were observed with the acceptability of appearance of ice creams with regard to roasting time and level of incorporation of cocoa mass but no significant difference was observed in the acceptability of appearance with the storage time of cocoa mass.

The same pattern was observed with the acceptability of colour, flavour and texture of ice cream. But regarding taste, acceptability was high with cocoa

mass incorporated at 5 per cent level but maximum treatment mean score was for cocoa mass roasted for 10 minutes (75.73%) followed by roasted for 5 minutes (74.74%). The differences in the treatment means were found to be significant. Here again significant differences were observed in the acceptability of taste with cocoa mass stored for different period, maximum score being for the products with cocoa mass stored for two months (73.39%). A same pattern with taste was found with biscuits also.

Overall acceptability of the ice cream was more among college students (74.18%) and least among school students (68.97%). Significant differences were observed between the scores obtained by different groups of panel members for colour, flavour, texture and taste of ice cream.

All the products were found to be highly acceptable at 5 per cent level of incorporation of cocoa mass prepared by 5 minutes roasting. Acceptable products were also obtained with cocoa mass roasted for 10 minutes at 5 per cent level incorporation. Ten per cent level incorporation was acceptable only when the cocoa mass is roasted for 5 minutes This indicated that if cocoa mass has to be incorporated at 10 per cent level to get an acceptable product, the roasting time has to be reduced to 5 minutes though microbial load was found to be significantly high.

For most of the products there was no significant changes in the acceptability of the products made with cocoa mass stored for different periods. In the present study cocoa mass was stored under ambient conditions and by the end

of third month clumping was observed resulting in less free flowness of cocoa mass.

Microbial and peroxide value showed a gradual increase from the initial period. Hence the cocoa mass cannot be used upon storage. But organoleptically the products were acceptable.

Acceptability of the products were found to be high among college students.

Summary

6. SUMMARY

The present study entitled 'Standardisation and acceptability of dairy products with cocoa mass was designed to standardise dairy products incorporated with cocoa mass and to evaluate its acceptability.

The cocoa beans roasted for 5 minutes and 10 minutes were powdered and stored for three months under ambient condition were assessed at monthly intervals. The 5 products viz milk chocolate, burfi, fudge, biscuit and ice cream were standardized incorporating cocoa mass at 5 and 10 per cent levels and also at monthly intervals using stored cocoa mass.

From the present study it was seen that the powder got clumped by the third month and became pale brown in colour.

The solubility of cocoa mass in warm water was not satisfactory.

The microbial population increased for both 5 minutes roasting and 10 minutes roasting during storage. But the formation was found to be significantly low for 10 minutes roasting.

Peroxide value also increased with storage for both 5 minutes roasting and 10 minutes roasting. But 10 minutes roasting showed relatively low values. All the products were found to be acceptable throughout the storage study.

All the products were found to be highly acceptable at 5 per cent level of incorporation of cocoa mass. But the time of roasting in the preparation of cocoa mass was found to have an influence on the acceptability of certain quality criterias of the products.

For milk chocolates 5 minutes roasting of cocoa beans was found to be highly acceptable for criterias like appearance (80.95%), flavour (77.22%), texture (75.62%) and taste (81.83%), but colour of the chocolate was highly acceptable with cocoa mass prepared by 10 minutes roasting (77.84%). There was no significant changes in the acceptability of chocolates due to the storage of cocoa mass for 3 months.

For burfies with cocoa mass 5 minutes roasting of cocoa beans was found to be highly acceptable for all the criterias and there was no significant changes in the acceptability of burfies due to the storage of cocoa mass for 3 months.

In the preparation of fudge, acceptability was high with cocoa mass made by 5 minutes roasting of cocoa beans for appearance (80.56%) and colour (81.89%), but highly acceptable fudge with regard to flavour (75.81%), texture (70.52%) and taste (78.94%) was obtained by cocoa mass made by 10 minutes roasting. Storage period of cocoa mass was found to have a significant influence on the acceptability of texture and taste of the fudge. Texture being highly acceptable with fudge made of cocoa mass stored for 2 months (69.67%) and taste with cocoa mass stored for one month (76.13%).

All the criterias of biscuits were highly acceptable with cocoa mass made by 5 minutes roasting of the beans. Here again the taste of biscuits were found to be most acceptable for biscuits made with cocoa mass stored for 2 months (69.22%).

Five minutes roasting of cocoa beans produced most acceptable ice creams with regard to appearance (78.22%), colour (75.33%), flavour (72.78%) and texture (72.11%) but for taste 10 minutes roasting was the most acceptable

treatment (75.73%). Taste was also found to have maximum acceptability with cocoa mass stored for 2 months (73.39%).

Among different groups of panel members acceptability of all the products were very high among college going students.

From the results of the study it was concluded that 5 per cent level of incorporation of cocoa mass was ideal for maximum acceptability of dairy products. Effect of roasting time of cocoa beans for 5 minutes and 10 minutes varied with the products.

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* Original not seen

Appendices

APPENDIX

Month :

SCORE CARD FOR THE EVALUATION OF COCOA PRODUCTS

Name :

Date :

Name of the products :

Criteria	Score	A	B	C	D
<u>Appearance</u>					
Very good	5				
Good	4				
Fair	3				
Satisfactory	2				
Poor	1				
<u>Colour</u>					
Very good	5				
Good	4				
Fair	3				
Satisfactory	2				
Poor	1				
<u>Flavour</u>					
Very good	5				
Good	4				
Fair	3				
Satisfactory	2				
Poor	1				
<u>Texture</u>					
Very good	5				
Good	4				
Fair	3				
Satisfactory	2				
Poor	1				
<u>Taste</u>					
Very good	5				
Good	4				
Fair	3				
Satisfactory	2				
Poor	1				

Signature :

STANDARDISATION AND ACCEPTABILITY OF DAIRY PRODUCTS WITH COCOA MASS

**By
SUNITA NAIR**

ABSTRACT OF THE THESIS

**Submitted in partial fulfilment of the
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ABSTRACT

Standardisation and acceptability of dairy products namely milk chocolate, burfi, fudge, biscuits and ice cream were conducted by incorporating cocoa mass at 5 per cent and 10 per cent levels. The cocoa beans were roasted for 5 minutes and 10 minutes Shelf life of cocoa mass for three months was also assessed under ambient conditions.

The results of the study indicated that the cocoa mass which was initially a powder got clumped by the third month and was insoluble in warm water.

The microbial count and peroxide values in cocoa mass increased gradually for both 5 minutes and 10 minutes roasting and recorded highest during the third month. Comparatively cocoa mass made by 10 minutes roasting had significantly low microbial count and peroxide value.

The sensory evaluation of milk chocolate showed the products incorporated with cocoa mass at 5 per cent level were more acceptable. Ten per cent level was acceptable if the cocoa beans were roasted for 5 minutes

The sensory evaluation of burfi showed 5 per cent level of incorporation of cocoa mass to be more acceptable. Five per cent level and roasted for 5 minutes were found to have optimum scores. Ten minute roasting with 10 per cent incorporation of cocoa mass made the product bitter and flowy.

The sensory evaluation of fudge showed that there was a significant decrease in the Period mean of acceptability of texture and taste of fudge by the

third month, thus 5 per cent incorporation of cocoa mass with cocoa beans roasted for 5 minutes was found to have the highest acceptability.

The Period mean of taste of biscuit increased upto the second month. During the third month significant decrease was observed. Five per cent level incorporation of cocoa mass was more acceptable.

The taste of ice cream showed a significant decrease in Period mean by the third month. Five per cent level incorporation of cocoa mass was found to have better acceptance in all criterias.

Thus it was observed that 10 per cent level of cocoa mass incorporation which was roasted for 10 minutes, resulted in least acceptable products. If the cocoa beans were roasted for 5 minutes, it was better accepted. All the products were found to be highly acceptable at 5 per cent level incorporation of cocoa mass especially 5 minutes roasting gave a better result.

All the five products were more acceptable by the panel members selected from college going students.