FORMULATION AND SENSORY EVALUATION OF READY TO EAT WHIPPED CHOCOLATE DAIRY DESSERT. (CHOCOLATE MOUSSE)

By

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DECLERATION

The work described in this thesis carried out by me at the Newdale Dairies (Pvt.)Ltd,100,Delgoda Road , Biyagama under the supervision of Mr. N.S Pathirana and Mrs. W .M. Deepika Priyadharshini. A report on this has not been submitted to another university for another degree.

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AFECTIONALY DEDICATED TO

MY LOVING PARENTS

AND

TEACHERS

Acknowledgement

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ABSTRACT

Ready to eat whipped Chocolate dairy desserts can have many nutritional and sensory advantages over home made desserts, with fresh taste, digestibility and higher vitamin level. Therefore studies were carried out to formulate Chocolate dairy Mousse with good sensory appeal.

Three samples were prepared by changing level of Sugar as 12%, 14.5%, 16%, while keeping other ingredients constant. Organoleptic qualities of samples were evaluated with 25experienced taste panel using nine hedonic scales. Physicochemical changes pH, microbiological changes were observed over the 21 days of storage at 4°C and 8°C with three days interval. Final product was analyzed for total solids, fat, Total soluble solids, pH.

Difference was existed between the samples prepared with various sucrose levels in the attributes of appearance, texture, flavour, colour, sweetness, mouth feel, overall acceptability. Highest rating was obtained by the sample with 16% sugar. CREMODAN®MOUSSE 32 was able to maintain fine air distribution with excellent foam stability, body and creaminess. No changes were found in pH, fat, total solid, Total soluble solids in samples stored at 4°C and 8°C throughout the storage period of 27 days. No Yeast and Mould growth were found throughout the storage and no coliforms were detected.

The whipped chocolate mousse produced with added 16% sugar, 36.11 % total solids, 12% total soluble solids, 6.00% fat and18.10 % Milk solids non fat and showed 21 days of storage life at 4 °C to 8° c without any deterioration in appearance, colour, flavour, sweetness, texture.

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ABBREVATIONS

MSNF	- Milk Solids Non Fat
TSS	– Total Soluble Solids
et al	- And others
Anon	- Anonymous

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CHAPTER 1

1.1 Introduction

Over the years the demand for dairy desserts, sweet products based on milk, and thickened or set by incorporating stabilizers, has increased. Among various types of dairy desserts, aerated desserts such as mousses are similar in composition to ice-cream, but their structure is stabilized by adding high levels of stabilizers, instead of freezing. (Early, 1998)

The product is traditionally a high fat milk product, highly whipped to achieve required degree of aeration and stability at ambient temperature. But health concern consumers' requirement, nowadays, is fulfilled by mousse with lower fat content.

In the manufacturing process air has to be incorporated to main acceptable texture. As Man and Jones, 1994 mentioned mousse should retain its texture and overrun without collapsing during its shelf life. Therefore maintenance of uniform texture during the shelf life is essential to maintain its quality.

Lethuaut, 2003, has investigated the effect of sweetness-texture interaction in model dairy desserts. Lethuaut further revealed that for each carrageenan composition (β, λ, κ-carrageenans or an equal weight mixture of the three), sweetness is significantly increased with sucrose.

Therefore in a product development of mousses selection of emulsifier / stabilizer system, to regulate and control air distribution, creaminess, smoothness, elasticity is an important event.

The ready to eat dairy mousse will therefore add new dimensions to the homemade milk mousses.

1.1 Objectives

Therefore this study was carried out with following objectives.

a. Identification of best formula for whipped chocolate mousse dairy dessert mixture
b. Identification of the most suitable stabilizer
c. Diversification of the dairy dessert market

CHAPTER 2

2.0 Literature Review.

2.1 Cow's milk and it's composition

2.1.1 Definition of Milk

The lacteal secretion, practically free from colostrum, is obtained by the complete milking of one or more healthy cows. It contains, not less than, 8.25 % of milk solids –non-fat 3.25% of milk fat. (Webb et al, 1987)

2.1.2 Composition of cow's milk

Milk from cows will vary in composition depending upon many factors. These include the breed of cow, individuality of the animal, age of the animal, stage of lactation, season of the year, the cow's feed, time of milking, period of time between milking, and the physiological condition of the cow.
(Varnam and Sutherland, 1994)

Table 2.1 Approximate composition of cow's milk

Constituents	%
Water	87.1
Fat	3.9
Protein	3.3
Lactose (milk sugar)	5.0
Ash (minerals)	0.7
Solids-not-fat	9.0
Total solids	12.9

Source: Potter, N.N, 1978, Food Science

a. Milk protein

The principal protein of milk, casein, makes up 80% of the total, while lactalbumin and lactoglobulin, also known as the serum proteins, make up the remaining 20%. Skim milk protein is designated to consist of 45% to 56 % α_s-casein, 8% to 15 % κ-casein , 25% to 35% β-casein, 3% to 7% γ casein, 2% to 5% lactalbumin ,7% to 12% blood serum albumin, 1% to 2% Ig G1 and 0.2% to 0.5% Ig G2 immunoglobulin ~ 0.1 to 0.2% Ig M immunoglobulin, ~0.05 to 0.10% Ig A immunoglobulin, and 2% to 6% proteose-peptone fraction.(Webb et al,1987)

b. Milk Fat

Milk fat is the most variable of all milk components which varies between any average value of 3.5% to 3.7 % .The mixture of mixed triglycerides which makes up 98% to 99% of milk fat is peculiar to milk, though quite bland in taste. It imparts smoothness and palatability to fat containing dairy products. The remaining 1% to 2% of milk fat is composed of phospholipids, sterols, carotenoids, the fat-soluble vitamins A, D, E, K, and some traces of free fatty acids. (Webb et al,1987)

c. Lactose

Lactose is the major solid constituent of milk. The concentration varies with yield between 4.2% and 5.0%. Lactose is a disaccharide and it comprises of α-D-glucose and β-D-galactose molecules. Three solid forms of lactose exist viz, α-lactose monohydride, anhydrous α- and β-lactose. Lactose is one of the least soluble of the common sugars, having a solubility of only 17.8% at 25°C in water. (Varnam and Sutherland, 1994)

d. Minerals

The minerals in milk consist principally of bicarbonates, chlorides, citrates, and bicarbonates of calcium, magnesium, potassium and sodium. All of these minerals are distributed between a soluble phase and a colloidal phase. Around 66% of the calcium and 55% of the phosphorous is found in colloidal phase. (Varnam and Sutherland, 1994)

2.1.3 Physical properties of milk

Table 2.2 Physical properties of milk

pH value at 25°C	6.6
Specific gravity (at 220°C)	1.032
Freezing point	-0.5400°C
Boling point	100.170°C
Viscosity at 200°C	1.6314 c poise
Surface tension at 200°C	50 dynes/cm
Heat capacity	0.52 cal/g

Source: Webb et al, 1987, Fundamentals of food chemistry

a. Freezing point

Milk has a freezing point, which is quite constant and is generally given as - 0.55°C. This mainly depends upon the soluble constituents such as lactose and chlorides. (Atherton and Newlander,1987)

b. Boiling point

The average temperature of boiling milk is around 100° C to 101 °C. This average may be slightly higher with milk containing larger percentages of solids. (Atherton and Newlander,1987)

c. Specific gravity

The average specific gravity of normal whole milk is 1.032 at 16° C. Milk low in fat will have a lower specific gravity and conversely milk rich in fat will have a higher specific gravity. (Atherton and Newlander,1987)

d. Surface tension

The surface tension of skim milk, whole milk, and cream which consist of 30 to 35 percent of fat is, 57.4, 55.3 and 49.6 dynes respectively. An increase in fat and protein content lowers the surface tension of milk. Pasteurization increases the surface tension to a small extent while homogenization lowers the tension. (Atherton and Newlander,1987)

e. Viscosity

Whole milk having fat average of 4.32 percent has an average viscosity of 1.6314 centipoises while skim milk has 1.404 centipoises of average viscosity. Milk is more viscous due to the presence of casein, fat, and albumin. (Atherton and Newlander,1987)

2.1.4 Milk Cream

Creams are manufactured to have a range of fat around 12% to 80%. This percentage depending upon the speed of the separator, the temperature of the milk, the rate of milk flow, and the number of times the product is passed through the separator. The whippability of cream depends upon the fat content, the age of the cream, the type of beater, and cream temperature. Adding non- fat dry milk solids usually improves whipping ability. (webb et, al,1987)

Table 2.3 Minimum fat standards for market creams in the United States and the United Kingdom

Type of Cream	Minimum Fat Required	
	Federal	States
	%	%
Half and half	–	10-12
Light, table, coffee	18	16-20
Medium	–	24-30
Whipping	30	30-36
Heavy whipping	36	34-36
United kingdom		
Half and half	12	
Sterilized half and half	12	
Cream	20	
Sterilized cream	23	
Whipping cream	35	
Whipping cream	35	
Double cream	48	
Clotted cream	48	

Source : Webb et al, Fundamentals of food chemistry,1987

2.2 THE COCOA PLANT AND NUTRITIONAL VALUE OF COCOA POWDER

2.2.1 The Origin of the cocoa plant cultivation

The cultivated cocoa plant, the botanical name of which is *Theobroma cacoa* L. belongs to the Sterculiaceae family. The Genus *Theobroma* contains some 22 species, all originating in the tropical rainforests of equatorial America, and some of these species are grown locally for making cooked dishes, gellies or refreshing beverages.

2.2.2 The food value of cocoa powder

Cocoa powder and chocolate contain a proportion of carbohydrates, fats, and protein together with some vitamins of the vitamin B complex. In addition to these, milk chocolate will contain, milk protein, calcium, other minerals and vitamins. Both cocoa powder and chocolate have a high calorific value. Chocolate is a nutritious and highly concentrated food, which "brings colour and excitement into everyday lives," (Anon, 1979).

Table 2.4 Analytical data for cocoa powder (mean of 10 samples of 2 brands)

Nutrient (g per 100 g)		Element (mg per 100 g)	
Protein	18.5	Sodium	950*
Fat	21.7	Potassium	1500*
Carbohydrate	11.5	Calcium	130
Energy value		Magnesium	520
K cal	312	Iron	10.5
K J	1.301	Copper	3.9
		Phosphorus	660
		Chlorine	460

*These values would be expected to vary with the manufacturing process.

Source: Paul and Southgate, 1978, The composition of foods

2.3 Dairy DESSERT

2.3.1 Definition of Dairy dessert

The term dairy dessert refers generally to a range of sweet products, based on milk, which are thickened or set by the incorporation of a suitable gelling agent and/or a stabilizer.

2.3.2 Ready –to-eat-desserts

A further convenience advantage offered by industrially prepared ready to eat desserts is the long shelf life products distributed at ambient temperatures or short shelf–life (3-6 weeks) products distributed chilled (5-10°C). These products are usually packed in one-portion cups or 0.5 l family packs; 1-1 Tetra Brick packs are also used for long shelf-life creamy desserts. (Early, 1998)

2.3.3 Aerated Desserts

Mousse, like ice cream, is an aerated dessert. But freezing stabilizes the structure of ice cream while the structure of mousse is maintained by the use of foam stabilizers. Mousse is traditionally a high-fat milk product, highly whipped to achieve the required degree of aeration and stability at ambient temperature. The modem product has a lower fat content, being of a similar composition to ice cream, with the resistance to melt and syneresis achieved by the added stabilizer. The incorporation of air into mousse can be achieved by several methods, and the foam structure varied from open to closed with a fine air cell distribution. Texture as well as foam stability may vary according to the stabilizer system used and the processing conditions involved. (Early, 1998)

Mousse may be whipped for varying periods to obtain either high or low overruns depending on the final textural characteristics required. In all cases a mousse should have uniform air cells. It should retain its texture and overrun without collapsing during its shelf life.

Table 2.5 Typical composition of industrially manufactured mousse

Constituent	Vanilla mousse (%)	Chocolate mousse (%)
Milk fat	7.00	7.00
MSNF	11.70	10.20
Sugar (sucrose)	11.00	11.00
Emulsifier/ stabiliser	2.80	2.50
Vanilla flavour	0.20	–
Chocolate flavour	–	1.00
Cocoa powder	–	2.50
Total solids	32.70	34.20

Source: Early.R,1998, The Technology of Dairy Products

2.3.3.1 The Composition of Mousse

The fat content of mousse varies typically from 5% to 8%. A fat free mousse will have a very closed structure, whereas a high-fat mousse will have a more open-structured. A MSNF (milk solid non fat) content below 7% results in a lack of body and a watery consistency. A MSNF content above 12% results in a mousse with a heavy body, thus loosing some of its characteristic light, foamy structure. The recommendations for protein content fir mousse is situated around 9%. It's sucrose content may vary between 8 % to 15%. Below 8% sugar mousse becomes rather insipid. The total solids content should generally be kept at a minimum of 31% in order to obtain a good body and consistency. (Early, 1998)

2.4 Milk Dessert Ingredients

2.4.1 Milk

In dairy desserts milk and milk proteins are the main ingredients. The protein level and the stability of the casein micelles of milk are important for an optimal interaction between casein and carrageenan. Higher milk fat contents results in higher dessert viscosities. Firmness and cohesion of the dessert are only slightly influenced by a change in milk fat content. Sensory testing of these desserts indicates that a minimum of 0.5% milk fat and preferably about 1.5% milk fat is necessary to create a rich, creamy mouth feel of the dessert. (Early, 1998)

2.4.2 Inulin and Oligofructose

2.4.2.1 Technological benefits of Inulin

RAFTILINE®GR and RAFTILINE® HP allow 100% fat replacement in aerated dairy products. They guarantee a creamy, smooth and fat like mouth feel and result at the same time in an extra stabilization effect.(Coussement. P , 1998)

2.4.2.2 Nutritional benefits of Inulin

Inulin and oligofructose are dietary fibers. Like all dietary fibers, they are not digested in the stomach or small intestine. However, because they are completely fermented in the colon, they contribute to better gut function, improve regularity and reduce constipation. Both inulin and oligofructose are selectively fermented by *Bifidobacteria* and boost the total number of these micro-organisms present in the colon. *Bifidobacteria* are known to have a number of beneficial effects on our health.

Because RAFTILINE® and RAFTILOSE® pass through the upper gastro-intestinal tract intact and are then selectively fermented in the intestine, they cause a positive change of the micro floral composition of the colon. When nutritionists discovered this, the prebiotic concept was born.

As the average age of the population increases, and as each one of us becomes older, we need to take a closer look at how we take care of our internal calcium balance. Inulin and oligofructose allow us to make the best use of the calcium present in our daily diet.

Because inulin and oligofructose are not digested in the stomach or in the small intestine, they have no effect on blood glucose levels. They are therefore suitable for diabetics.

The non-digestibility of inulin and oligofructose forms the basis of their reduced caloric contribution to the human system compared to their monosaccharide moieties. This makes them very popular as fat and sugar replacers in calorie reduced foods. The search for improvement and new nutritional applications is on-going. New studies are finding data, which point to potential beneficial effects of inulin and oligofructose on lipid metabolism and cancer inhibition.

Inulin is a prebiotic dietary fiber with a reduced caloric value and suitable for diabetics. Inulin is a natural food ingredient that is found in more than 36,000 plants including leeks, onions, artichokes, garlic, and wheat. It is also present in large amounts in chicory roots from which is extract it. Oligofructose is a natural constituent of inulin. (Coussement. P , 1998)

2.4.2.3 Production process

Inulin is extracted from the chicory roots using hot water. Oligofructose is then obtained from inulin using a natural process.

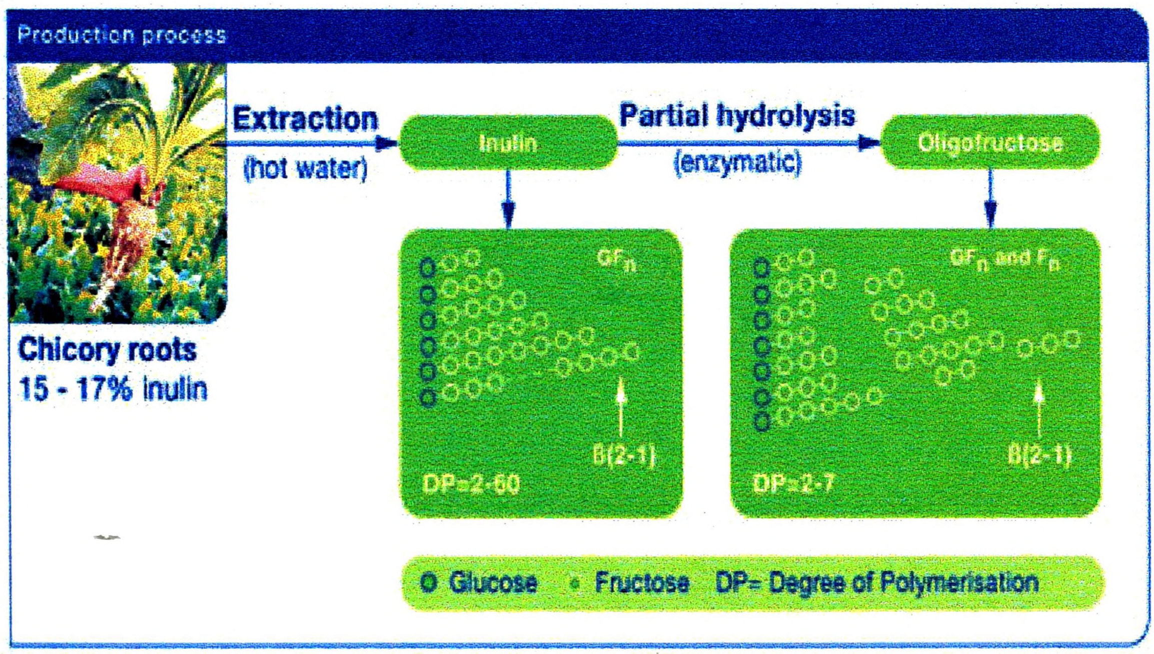

Figure 2.1 Inulin and oligofructose extraction process

Source: Coussement. P , 1998, Application File Dairy Desserts.

Inulin and oligofructose are composed of linear chains of fructose units linked by ß(2-1) bonds and often terminated by a glucose unit. Inulin contains chains with up to 60 fructose units. Oligofructose has between 2 and 7 fructose units. Oligofructose is obtained from inulin by partial enzymatic hydrolysis.

2.4.3 Emulsifier and Stabiliser Systems

The use of selected emulsifier/stabilizer systems makes it possible to regulate and control parameters such as

Air distribution

Creaminess

Smoothness

Brittleness/elasticity

The emulsifier has a very important role: it helps to aerate the product, it helps the incorporation of air and a good distribution of the fat phase in the product. (Early, 1998)

Table 2.6 Emulsifier / Stabilisers Commonly used in Dairy Mousse

Emulsifiers	**Stabilisers**
Mono-diglycerides of fatty acids	Gelatine
Lactic acid esters of monoglycerides	Alginate
	Carrageenan
	Microcystalline cellulose
	Modified starch
	Pectin

Source :Early, 1998, The Technology of Dairy Products

2.5 Microbiology of Dairy Desserts

Table 2.7 Four Grades of standards suggested for dairy desserts (Counts per Gram)

	Target	Acceptable	Doubtful	Reject
Viable count	<1000	1000-5000	5000-20000	>20000
Coliforms	<10	10	10-100	>100
Yeasts	<10	10-50	50-100	>100
Moulds	<10	10-50	50-100	>100

Source: Robinson, 1981, Dairy Microbiology

2.6 Mousse Processing

a. Mixing

During mixing it is important to avoid air intake, as problems such as burn on in the pasteurizer and uneven homogenization are related to excessive air in the mix. Both problems lead to inferior mousse quality. Sufficient time is given prior to heat-treatment for powdered ingredients, particularly milk powders, to rehydrate. Inadequate rehydration can limit the water-binding interactions of ingredients such as milk proteins and stabilizers and may also result in a powdery mouth feel in the finished product. (Early, 1998)

b. Heat Treatment

Mousse mix is subjected to high-temperature-short-time (HTST) heat-treatment of 80-85 ^{0}C or 20-30s,in order to achieve some denaturation of the whey proteins resulting in improved water binding properties. This is advantageous, as a creamier product with a smoother texture and better body is obtained. Long life and ambient mousse is produced by aseptic processing with UHT heat-treatment conditions of typically 140-145 ^{0}C for 3-5 s. (Early, 1998)

c. Homogenization

The mousse mix is generally homogenized at a pressure, which is 25% lower than that is applied to an ice-cream mix with the same fat content. Homogenization can be used as a tool to control the structure of mousse. The finer the fat emulsion, the finer the structure in the finished mix. The position of homogenization will depend on the process and may be either up-stream or down-stream of the heat-treatment step. With UHT processes using direct heat-treatment, homogenization is best carried out down stream, otherwise the sterilization process will destabilize the fat emulsion, possibly inhibiting the production of an aerated foam and reducing the stability of the final product. (Early, 1998)

d. Ageing

A short ageing period of 30-60 min prior to aeration is common for pasteurized products and produces better performance in the aerator. A longer ageing period is avoided for bacteriological reasons. As in most cases, mousse contains gelatine, the ageing temperature is kept above 25^{0}C in order to prevent the mix from gelling. Products, which contain alginates and carrageenans are kept above 60^0 C to avoid gellation, and then cooled to 5^0 C immediately prior to aeration. (Early, 1998)

e. Aeration

Industrial mousse products are generally whipped in a continuous aerator or in an ice-cream freezer. It is easier to control the mousse structure in the former, as in the latter, an open structure may be difficult to produce. The overrun may vary from 20% to 150%, but an overrun of around 60-100% is most common. Air may be incorporated in the whipping of pasteurized mousse, while nitrogen is commonly used in the production of UHT long-life and ambient mousses. (Early, 1998)

f. Addition of Particulate ingredients and Flavours

The addition of fruit pieces and other particulate ingredients is carried out after aeration by using an ingredient feeder for in-line blending, so as to avoid damage and attrition of the added material. Such ingredients are suitably heat-treated prior to use, to avoid the introduction of contaminant organisms. The method of incorporation will be such as to avoid recontamination of the ingredient and mousse, particularly where aseptic processing is employed. Some flavours, particularly those, which are heat sensitive, may also be incorporated into the mousse base following aeration. (Early, 1998)

g. Packing

Mousse is packed into a variety of container formats, depending on the shelf-life of the product and the target market. It is important, however, that filling lines be kept as short as possible to avoid the mousse setting before reaching the container. (Early, 1998)

h. Overrun

The increase in volume affected by whipping air in to the mix during the freezing process is known as "overrun". The beater or dasher is allowed to revolve in order to incorporate the air in the ice cream. Whipping should be completed in two or three minutes in order to prevent the ice cream from melting through lack of refrigeration. In the continuous freezer, whipping is accomplished automatically while the mix passes through the freezer .

The formula for the calculation of overrun is:

$$\% \text{ Overrun} = \frac{\text{Gallons of Ice Cream} - \text{Gallons of Mix}}{\text{Gallons of Mix}} * 100$$

When weight is used, the formula becomes;

$$\% \text{ Overrun} = \frac{\text{Weight of Mix (lbs) - Weight of Ice Cream (lbs)}}{\text{Weight of Ice Cream (lbs)}} * 100$$

(Lampert, 1970)

CHAPTER 3

3.0 Materials and Methods

The research was conducted at the laboratory of the Newdale dairies (Pvt) Limited, 100, Delgoda Road, Biyagama, Sri Lanka.

3.1 Materials:

Apparatuses

Electric balance (capacity maximum 3100.00 g –minimum 0.01 g)
Laboratory Homogenizer
Laboratory blender
Aerator (Beater)
Thermometer
Water bath

Raw materials

Fresh Milk
Sucrose
Cocoa powder
RAFTILINE® GR (Inulin)
CREMODAN ®MOUSSE 32 (stabilizer)

Methods:

The preliminary tests were conducted to select the most suitable stabilizer for dairy fat base ready to eat whipped chocolate mousse.

Organoleptic evaluation was carried out with experienced panel to determine appropriate sugar level for whipped chocolate mousse by changing sugar content 12%, 14.50% and 16% respectively. Data were obtained for Appearance, Flavour, Colour, Texture, Mouth feel, Sweetness and Overall Acceptability.

The physical changes of the product during the storage were carried out by keeping product under 4 °C and 8° C.

3.2 Experiment 1: Formulation of chocolate base mousse

Fresh milk (3.5% fat), Skimmed milk powder, RAFTILINE® GR, Sugar, Cocoa powder (22% fat) CREMODAN ®MOUSSE 32 were weighed.

RAFTILINE® GR was allowed100% fat replacement in aerated dairy products. CREMODAN ®MOUSSE 32,was used to maintain high gel strength with closed structure of chocolate mousse. CREMODAN ®MOUSSE 32was yellowish blend of food graded emulsifier and stabilizer in powder form.

Milk was pre-heated to 40 °C and the dry ingredients were dispersed in to the milk by using laboratory blender. During the blending CREMODAN® MOUSSE was added in to the mixture. Then the mixture was homogenized at 70-75 °C/150bar(2100 psi). Then mixture was pasteurized at 85°C for 20 seconds .It was cooled to approximately 15 °C by agitating slowly (Age for minimum 30 minutes). Flavours were added in to the mixture. Then the mixture was whipped by using aerator to 100% overrun. Then the product was stored at 5° C.

Preparation of CREMODAN ®MOUSSE 32 solution

CREMODAN ®MOUSSE 32 was mixed with small amount of sugar. Then fresh milk was added in to the sugar stabilizer mixture. Mixture was heated to a temperature above 40° C.

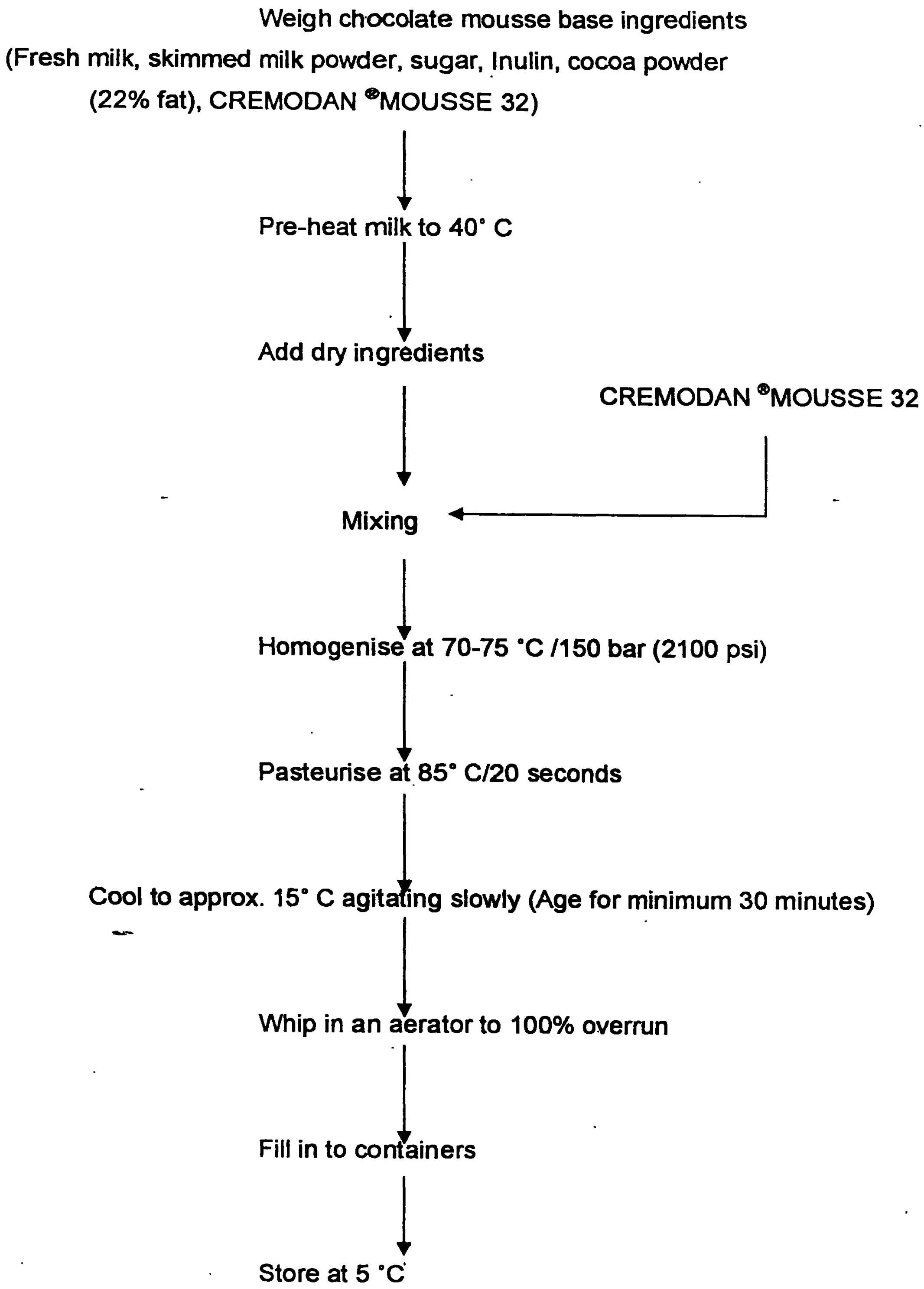

Figure 3.1 Formulation of Chocolate mousse

3.2.1 Selection of most suitable stabilizer

Table3.1. Following stabilizers and combination of stabilizers were used to determine the most suitable stabilizer.

Treatment number	**stabiliser**
1	Carrageenan with modified starch GRINSTED® Pectin
2	GRINSTED® Pectin
3	Cremodan
4	DIMODAN (mono and diglycerides of fatty acids)
5	Recodan (carrageenan, Guar-gum, Ca^{2+} mono and diglycerides of fatty acids)
6	Recodan(carrageenan,Guar-gum,Ca^{2+}mono and diglycerides of fatty acids) DIMODAN (mono and diglyceride of fatty acids)
7	GRINSTED® Pectin DIMODAN (mono and diglyceride of fatty acids)
8	Cremodan DIMODAN (mono and diglyceride of fatty acids)
9	Cremodan GRINSTED® Pectin
10	Recodan(carrageenan,Guar-gum,Ca^{2+}mono and diglycerides of fatty acids) DIMODAN (mono and diglyceride of fatty acids) GRINSTED® Pectin
11	DIMODAN (mono and diglyceride of fatty acids) Modified starch GRINSTED® Carrageenan GRINSTED® Pectin
12	CREMODAN®MOUSSE32
13	CREMODAN®MOUSSE34

3.2.2 Determination of percentage of sugar: stabilizer ratio

The dosage levels of CREMODAN ®MOUSSE 32 depend on the total solids in the mousse formulation and the desired texture in the final product. The sugar was added in different percentages, while keeping other ingredients constant. Table 3.1 shows the percentage of sugar used in different treatments.

Table 3.2 Percentage of sugar used in different treatments

Treatment code	Percentage of sugar
327	14.50 %
275	12 %
417	16 %

3.2.2.1 Evaluation of organoleptic qualities

Three taste panels were used to carry out organoleptic evaluation during the month of February at the laboratory of Newdale Dairies (Pvt) Limited. Same panelists were evaluated the sensory properties of three replicates of three treatments in order to reduce the biasness.

The organoleptic characters were tested for Appearance, Flavour, Colour, Texture, Mouth feel, Sweetness, Overall Acceptability. The panel was consisted of 25 experienced panelists.

3.2.2.2 Serving of samples

The samples were coded with three digit random numbers drawn from random number table.

3.2.2.3 Testing criteria

The nine point hedonic scale was used to evaluate the degree of liking for particular quality attribute. (Annexure 1)

3.2.2.4 Statistical Analysis of Data

A non-parametric ranking procedure was used with Friedman test for the evaluation of Appearance, Flavour, Colour, Texture, Mouth feel, Sweetness and Overall Acceptability. Data were analysed using the software MINITAB at 0.05 significant levels.

3.3 Experiment 2: Assessment of physico -chemical properties of ready to eat whipped chocolate mousse.

3.3.1 Proximate analysis of the chocolate mousse.

The final developed sample was analysed for proximate composition of total solids, pH, MSNF, and Fat using standards methods.

3.3.1.1 Determination of Total solids

Sartorius AG GOTTINGEN MA 30-000V3-moisture analyzer was used to detect total solids in final product. The balance was zero and drying cover was open. Aluminium pan was mounted on the pan support .10g of quartz sand was kept on pan and it was tarred. Then 1.5 g of sample was placed on it and distributed evenly. Dryer cover was closed and start key was pressed. The result was indicated automatically.
(115 °C for 7 minutes)

3.3.1.2 Determination of pH

Mettler Toledo MP220 pH meter was used to determine the pH. pH meter was calibrated using buffer solutions of 4 and 7 at the beginning of the experiment until slope of the pH meter reached to 100. The electrode was rinsed with distilled water and blotted with soft tissue. The pH meter was inserted in to sample of chocolate mousse until stabilized the reading. Then represented reading was recorded. Test was done in four replicates.

3.3.1.3 Determination of MSNF content

2.5g of sample was placed on porcelain dish. One milliliter of phenolphthalein was added to it. Sample was titrated by using 0.1 N NaOH solution. 0.75 mililiter of formaldehyde was added to it in order to neutralize the sample. Then the mixture was titrated by using 0.1N NaOH solution (phenolphthalein-indicator). Volume of NaOH used was obtained (V1). 0.75 milliliter of formaldehyde was titrated by using 0.1 N NaOH. (V2) Percentage of MSNF of the product was calculated by using the following formula.(see Annexure 4)

MSNF Percentage by mass = 5.67 x (V_2-V_1)

3.3.1.4 Determination of Total fat

2.00 g of the sample was measured by using electric balance. Ten milliliter of HCl was prepared by using twenty- five milliliter of Concentrated HCl and one milliliter of water. Two milliliter of 95% ethanol and 10 ml of HCl were added into beaker. Then the mixture was mixed thoroughly. Then the beaker was placed on a water bath at 80 °C and stirred for 30-50 minutes. Beaker was removed from the water bath and content was transferred into separation funnel. The beaker was washed with 25 ml of ether in three portions of washing and it was added in to flask. Then the separation funnel was shaken vigorously for about few minutes. After twenty - five milliliter of pet ether was added and it was shaken again. This procedure was carried out for few minutes and the funnel was standed until clear layer of pet ether was appeared. Pet ether was removed from the funnel and collected to cleaned and weighed dried flasks. Then the flask was dried in a water bath at 90 °C until the constant weight was obtained. (see Annexure 3)

Weight of the flask = X_1 g

Weight of the flask with fat after dried in a water bath = X_2 g

Weight of sample = Y g

$$\text{Total fat percentage} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100$$

3.3.2 Microbiological Quality Assessment

Ready to eat whipped chocolate mousse was analysed for aerobic bacteria, Yeast, mould and coliforms.

3.3.2.1Aerobic plate count

Selected sample (code 417 /16% sugar) was agitated to ensure homogeneity. Three sterile Petri dishes were taken. The plates were labeled as date of plating, sample name and time/code. One gram of the sample was taken in to Petri dish by using a electric balance. Fifteen milliliter of molten Standard Plate Count Agar (SPCA) was tempered to 45 ±1 in to Petri dish. The time elapsing between the preparation of the sample and the addition of the agar must not exceed 15 minutes. The dish was rotate sufficiently to obtain evenly dispersed colonies after incubation. The agar was allowed to solidify at room temperature. Blank control plate was prepared by pouring 15 ml of molten SPCA agar in to a Petri dish. The procedure was done under sterilized Laminar flow. All the plates were incubate aerobically at 30 °C ± 1 for 72 ± 3 hrs.

3.3.2.2Yeast and Mould count

Selected sample (code 417 16% sugar) was agitated to ensure homogeneity. Nine sterile Petri dishes were taken. The plates were labeled with date of plating, sample name and time/code. 3.33 g of the sample was transferred in to three petri dishes.15 ml of molten Potato Dextrose Agar (PAD) was poured to Petri dishes at 45^0 C 1^0 C. The mixture was agitated immediately after pouring, by rotating the closed Petri dishes. The Agar was allowed to solidify at room temperature. The procedure was done under sterilized Laminar Flow cabinet. Then the plates were incubated at 25± 1 °C for 5 days. The colonies were counted using a colony counter in subdue light and the results were expressed as Yeast and Mould Colony Forming Units (CFU) per gram.

3.3.2.3 Coliform Detection

Selected sample (code 417 16% sugar) was agitated to ensure homogeneity. Three sterile Petri dishes were taken. The plates were labeled as date of plating, sample name and time/code.1.0 g of the sample was transferred in to the three petri dishes.15 ml of Violet Red Bile Agar (VRBA) was poured in to Petri dishes at 45 °C ±1 °C. The Petri dishes were mixed immediately after pouring by rotating the closed Petri dishes. The VRBA Agar was allowed to solidify at room temperature. The procedure was done under sterilized Laminar Flow cabinet. Then the plates were incubated at 35± 1 °C for 48 hrs. The colonies were counted using a colony counter in subdue light.

CHAPTER 4

4.0 Results and Discussion.

4.1Results

Results of the sensory evaluation test of selecting best percentage level of sugar were discussed below.

4.1.1 Result of sensory evaluation.

4.1.1.1 The effect of taste panel

The effect of the panel on the evaluation of quality parameters was not significant. So there was no any bias effect on the decisions made by the tasting panel. Also the panelist-to-panelist variation was not found in decision-making.

4.1.1.2 The effect of treatment on the Appearance of the whipped chocolate mousse.

The results of effect on the appearance of the mixture show the highest rank for the product which contained 16% sugar in the formula. According to data analysis it shows the significant difference between the samples, since probability value p=0.014 of the test is less than the minimum probability value p=0.05.According to the data sample with 16% sugar gained the highest sum of rank in the category of "Like moderately." Table 4.1 shows the effect of treatment on appearance.

Table 4.1 Effect of treatment on appearance

Code	**N**	**Est median**	**Sum of Ranks**
275	25	6.3333	40.5
327	25	7.0000	50.5
417	25	7.6667	59.0

4.1.1.3 The effect of treatment on the Flavour of the whipped chocolate mousse.

The results of effect on the flavour of the mixture show the highest rank for the product which contained 16% sugar in the formula. According to data analysis it shows the significant difference between the samples, since probability value p=0.000 of the test is less than the minimum probability value p=0.05.According to the data sample with 16% sugar gained the highest sum of rank in the category of "Like very much". This revealed that the most acceptable sugar percentage for chocolate mousse is 16% of sugar by weight.

Table 4.2 Effect of treatment on flavour

Code	N	Est median	Sum of Ranks
275	25	7.0000	36.5
327	25	7.0000	46.5
417	25	8.0000	67.0

4.1.1.4 The effect of treatment on the Colour of the whipped chocolate mousse.

The results of effect on the colour of the mixture show the highest rank for the product which contained 16% sugar in the formula. According to data analysis it shows the significant difference between the samples, since probability value p=0.002 of the test is less than the minimum probability value p=0.05. According to the data sample with 16% sugar gained the highest sum of rank in the category of "Like moderately". Table 4.3 indicates the result of the test.

Table 4.3 Effect of treatment on colour

Code	N	Est median	Sum of Ranks
275	25	6.6667	43.5
327	25	7.0000	45.5
417	25	7.3333	61.0

4.1.1.5 The effect of treatment on the texture of the whipped chocolate mousse.

The results of effect on the texture of the mixture show the highest rank for the product which contained 16% sugar in the formula. The data analysis shows that there is a significant difference between the samples, since probability value p=0.010 of the test is less than the minimum probability value p=0.05.According to the data sample with 16% sugar gained the highest sum of rank in the category of "Like very much".

Table 4.4 Effect of treatment on texture

Code	N	Est median	Sum of Ranks
275	25	7.0000	42.5
327	25	7.0000	46.0
417	25	8.0000	61.5

4.1.1.6 The effect treatment on the Mouth feel of the whipped chocolate mousse.

The results of effect on the mouth feel shows the highest rank for the product, which contained 16% sugar in the formula. According to data analysis it shows that there is a significant difference between the samples, since probability value p=0.00 of the test is less than the minimum probability value p=0.05.According to the data sample with 16% sugar gained the highest sum of rank in the category of "Like very much".

Table 4.5 Effect of treatment on Mouth feel

Code	N	Est median	Sum of Ranks
275	25	6.0000	33.0
327	25	7.0000	52.0
417	25	8.0000	65.0

4.1.1.7 The effect of treatment on the Sweetness of the whipped chocolate mousse.

The results of effect on the sweetness of the mixture show the highest rank for the product which contained 16% sugar in the formula. According to data analysis it shows that there is a significant difference between the samples, since probability value p=0.006 of the test is less than the minimum probability value p=0.05.According to the data sample with 16% sugar gained the highest sum of rank in the category of "Like moderately".

Table 4.6 Effect of treatment on sweetness

Code	N	Est median	Sum of Ranks
275	25	6.3333	41.5
327	25	7.0000	46.5
417	25	7.6667	62.0

4.1.1.8 The effect of treatment on the Overall acceptability of the whipped chocolate mousse.

The results of effect on the overall acceptability of the mixture show the highest rank for the product which contained 16% sugar in the formula. According to data analysis it shows that there is a significant difference between the samples, since probability value p=0.000 of the test is less than the minimum probability value p=0.05.According to the data sample with 16% sugar gained the highest sum of rank in the category of "Like very much".

Table 4.7 Effect of treatment on overall acceptability

Code	N	Est median	Sum of Ranks
275	25	6.0000	36.5
327	25	7.0000	47.0
417	25	8.0000	66.5

The results of sensory evaluation shows that the most acceptable percentage of sugar incorporate to chocolate mousse is 16% and which gives the highest acceptability in terms of Appearance, Flavour, Colour, Sweetness, Texture, Mouth feel and overall acceptability.

4.1.2 Most suitable stabilizer.

The results in the Table 4.8 show the ability of whipping properties and Gel forming ability of stabilizers and stabilizer combinations. With their abilities in development of such properties, it shows that CREMODAN®MOUSSE32 is the most suitable stabilizer for dairy mousse, which gives 100% overrun during the production process with fine air distribution.

Table 4.8 Selection of most suitable stabilizer

Stabilizer	**Whipping properties**	**Gel forming ability**
Carrageenan Pectin	Not whipped	Not gel formed
Pectin	whipped	Gel formed slightly
Cremodan	Not whipped	Not gel formed
Dimodan	whipped	Not gel formed
Recodan	whipped	Not gel formed
Recodan Dimodan	whipped	Not gel formed
Pectin Dimodan	Not whipped	Gel formed
Cremodan Dimodan	Not whipped	Not gel formed
Cremodan Pectin	Not whipped	Gel formed
Recodan Dimodan Pectin	whipped	Gel formed slightly
Dimodan Modified starch Carrageenan Pectin	Whipped	Gel formed (but not gives real texture of mousse)
CREMODAN®MOUSSE 32	Whipped 100% overrun	Gel formed-closed structure with high gel strength
CREMODAN®MOUSSE34	whipped	Gel formed-open structure of mousse

4.1.3 Proximate composition of Finish Product

The selected best sample with 16% sugar and CREMODAN®MOUSSE 32 gives the following proximate composition.

The Total solids level of the chocolate mousse is 36.11%. Total Fat percentage of the mousse is 6.00% and Milk solid non -fat percentage is 18.10%. pH of the product is 6.60 and Total soluble solids 12%.

Table 4.9 proximate composition of finished product.

Total Solids %	36.11
Fat%(dry basis)	6.00
PH	6.60
Total soluble solid percentage	12
MSNF %	18.10

4.1.4 The Result of the Evaluation of product during storages.

4.1.4.1.Physical changes during 4° C ± 1° C and 8° C ± 1° C storage

No discoloration, undesirable odor formation, or gas formation was observed after keeping for 21 days at temperatures of 4° C and 8° C storage. No Yeast, mould, or coliform growths were observed during the same period at same temperature.

4.1.5 pH changes during the storage

The pH changes during the period of 21 days are shown in the table 4.10.Results shows no significant difference between the storage periods.

The probability value ($p=0.32$) of the test is higher than the minimum probability value ($p=0.05$), that is required for the test to be significant. This indicates that there is no significant change in pH throughout the storage. Therefore Chocolate mousse can be stored at 4 °C± 1° and 8 °C± 1° without any changes in pH.

Table 4.10 pH changes during the storage

Storage temperature	3 days	6 days	9 days	12 days	15 days	18 days	21 days
4° C	6.60	6.60	6.59	6.58	6.58	6.58	6.57
8° C	6.60	6.58	6.58	6.57	6.57	6.57	6.55

The data was represented by the mean value of three replicates.

4.1.6 The Result of the Microbiological Quality Assessment.

No Yeast and Mould growth were observed during the 21 days at 4°Cand 8 °C. And No Coliform growth was observed in storages at 4 °C± 1° and 8 °C± 1°.Table 1.11 represents the test results.

Table 4.11 Microbiological Results

Days	Yeast and Moulds count	Aerobic plate count	Coliform count
0	0/1g	0/10g	0/1g
3	0/1g	0/10g	0/1g
6	0/1g	0/10g	0/1g
9	0/1g	0/10g	0/1g
12	0/1g	0/10g	0/1g
15	0/1g	0/10g	0/1g
18	0/1g	0/10g	0/1g
21	0/1g	0/10g	0/1g

4.2 Discussion

Chocolate Mousse prepared using milk is set by the incorporation of suitable gelling agent and a suitable stabilizer. Among three samples of Chocolate Mousse with 12%, 14%, 16% sugar respectively, the sample number 417 which contains 16% sugar gained the highest rank for Appearance, Flavour, Colour, Texture, Mouth feel, Sweetness, and Overall acceptability.

The sugar level of Mousse is very important quality attribute in terms of consumer acceptability. Sugar while maintaining sweetness it also helps to maintain the body of the product. Sweetness-texture interactions were investigated in model dairy deserts varying in both sucrose concentration and the carrageenan composition. (Lethuaut, 2003)

The texture of chocolate mousse is depends on the stabilizer added to the product. The use of selected emulsifier/satbiliser for systems makes it possible to regulate and control parameters such as: air distribution, creaminess, smoothness and elasticity. The results revealed that the most suitable stabilizer for Chocolate Mousse is CREMODAN®MOUSSE 32, which maintains fine air distribution, excellent foaming, good body creaminess with giving constant overrun during the production.

Proximate analysis of the product shows, 36.11% of Total solids, 6.00% of Fat, 12% of Total soluble solids, 18.10% of MSNF content and a pH of 6.60. It is better to have 100% overrun of the product. 100% overrun of the chocolate mousse was achieved by using the hand beater.

The storage life of the chocolate mousse is based on the heat treatment given to the product. Ultra High Temperature treatment was used to achieve this. The UHT treated (140-145°C for 3-5 s) Chocolate Mousse is able to withstand its organoleptic quality and microbiological quality for the period of 21 days at 4°C±1° and 8°C±1° without any change. Therefore it seems that product can be stored at 4°C±1° and 8°C±1° for 21 days with excellent quality characteristics. This will help in marketing aspects since customers can store their product in domestic refrigeration without quality deterioration.

The successfulness of the research depends on the good sanitary condition of the processing. And all the experiments were done under Good Manufacturing Practices, hence keeping good microbiological quality of the finished product.

It was interested to mentioned that introduction of the ready to eat Whipped Chocolate mousse can divert the existing market.

CHAPTER 5

5.1 Conclusion

According to the results obtained it can be concluded that the most acceptable percentage of sugar in a chocolate dairy mousse is 16% from the total weight.

And the CREMODAN®MOUSSE 32 is the best stabilizer / emulsifier system to impart fine air distribution, excellent foam stability with constant overrun during production.

The product can be stored between 4°C ±1° and 8°C ±1° without changes in appearance, taste, texture, flavour and sweetness.

5.2 Recommendation and further studies

a . Market research should be carried out to find the consumer acceptability of he product.

b. Further shelf life studies should be carried out.

c. Cost effective packaging material should be identified.

d. Further studies should be carried out at ambient storage temperature.

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ANNEXURE 1

Sensory Evaluation of Whipped Chocolate mousse.

Date ....

Name................................

*This is a milk-based mousse, which can be used as a ready to eat dairy dessert.

*Please taste 3 samples of the chocolate mousse and indicate your score against the sample code.

*The rating for such samples is given in numeric values ranging from 9 (Like extremely) to 1 (Dislike extremely) as given below.

Like extremely................................ 9
Like very much................................ 8
Like moderately 7
Like slightly.................................... 6
Neither likes nor dislikes..................... 5
Dislike slightly................................. 4
Dislike moderately........................... 3
Dislike very much............................ 2
Dislike extremely............................. 1

Quality character	Code Number		
	327	275	417
Appearance			
Flavour			
Colour			
Texture			
Mouth feel			
Sweetness			
Overall Acceptability			

Comments..
....
....

Thank you.

ANNEXURE 2

Friedman Test

Friedman test for Appearance by Code blocked by Treatment

S = 6.86 DF = 2 P = 0.032

S = 8.47 DF = 2 P = 0.014 (adjusted for ties)

Code	N	Est Median	Sum of Ranks
275	25	6.3333	40.5
327	25	7.0000	50.5
417	25	7.6667	59.0

Grand median = 7.0000

Friedman Test

Friedman test for Flavour by Code blocked by Treatment

S = 19.34 DF = 2 P = 0.000

S = 24.17 DF = 2 P = 0.000 (adjusted for ties)

Code	N	Est Median	Sum of Ranks
275	25	7.0000	36.5
327	25	7.0000	46.5
417	25	8.0000	67.0

Grand median = 7.3333

Friedman Test

Friedman test for Colour by Code blocked by Treatment

S = 7.34 DF = 2 P = 0.025
S = 12.23 DF = 2 P = 0.002 (adjusted for ties)

Code	N	Est Median	Sum of Ranks
275	25	6.6667	43.5
327	25	7.0000	45.5
417	25	7.3333	61.0

Grand median = 7.0000

Friedman Test

Friedman test for Texture by Code blocked by Treatment

S = 8.18 DF = 2 P = 0.017
S = 9.30 DF = 2 P = 0.010 (adjusted for ties)

Code	N	Est Median	Sum of Ranks
275	25	7.0000	42.5
327	25	7.0000	46.0
417	25	8.0000	61.5

Grand median = 7.3333

Friedman Test

Friedman test for Mouth feel by Code blocked by Treatment

S = 20.72 DF = 2 P = 0.000
S = 24.09 DF = 2 P = 0.000 (adjusted for ties)

		Est	Sum of
Code	N	Median	Ranks
275	25	6.000	33.0
327	25	7.000	52.0
417	25	8.000	65.0

Grand median = 7.000

Friedman Test

Friedman test for Sweetness by Code blocked by Treatment

S = 9.14 DF = 2 P = 0.010
S = 10.39 DF = 2 P = 0.006 (adjusted for ties)

		Est	Sum of
Code	N	Median	Ranks
275	25	6.3333	41.5
327	25	7.0000	46.5
417	25	7.6667	62.0

Grand median = 7.0000

Friedman Test

Friedman test for Overall acceptability by Code blocked by Treatment

S = 18.54 DF = 2 P = 0.000

S = 19.52 DF = 2 P = 0.000 (adjusted for ties)

		Est	Sum of
Code	N	Median	Ranks
275	25	6.000	36.5
327	25	7.000	47.0
417	25	8.000	66.5

Grand median = 7.000

ANNEXURE 3

Determination of Total fat

Weight of the sample	Weight of the flask	Constant Weight of fat with flask after dried in a water bath
2.0000 g	48.2844 g	48.2441 g
2.0000 g	48.2844 g	48.2410g
2.0000 g	48.2844 g	48.2411g
Average weight		
2.0000 g	48.2844 g	48.2410g

Weight of the flask = X_1 g

Weight of the flask with fat after dried in a water bath = X_2 g

Weight of sample = Y g

Total fat percentage $= \frac{\text{Weight of fat } (X_2 - X_1) \text{ X100}}{\text{Weight of sample } (Y)}$

The percentage of fat on wet basis $= \frac{(48.2844 \text{ g} - 48.2410 \text{ g}) \times 100}{2.0000 \text{ g}}$

= 2.17%

The percentage of fat on dry basis $= \frac{2.17 \times 100}{36.11 \text{ g}}$

= 6.00%

ANNEXURE 4

Determination of MSNF

Weight of the sample	**Volume of NaOH for the Sample V_2**	**Volume of NaOH for Blank V_1**
2.506 g	0.9 ml	0.1 ml
2.506 g	0.9 ml	0.1 ml
2.506 g	0.9 ml	0.1 ml
Average		
2.506 g	0.9 ml	0.1 ml

MSNF Percentage by mass = $5.67 \times (V_2 - V_1)$

V_2Volume of NaOH for the sample

V_1-Volume of NaOH for the blank

Volume of NaOH for calculation = (0.9 ml – 0.1 ml) x 4

= 3.19

MSNF percentage by mass = 5.76 x 3.19

= 18.10 %

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