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Ice cream as a mode of delivery of bioactive compounds: A review- based study

Gopika B, Chinju Baby and Athira Dileep

Abstract
Ice cream, frozen dairy product is considered as good source of energy in comparison to milk. But still the ice cream is deficient in many micro nutrients such as iron, vitamin C and dietary fiber, etc. On the other hand, marigold is underutilized edible flower in India. The interest in marigold flower can also be attributed to its nutritional value and multifunctional properties, with the special emphasis on the presence of certain beta carotene and antioxidant. The marigold petal is good source of bioactive compounds and has anti oxidative potential. The present study was undertaken to optimize the process parameters to manufacture a functional ice cream with added health benefits coming from marigold flower. Four variant of ice creams were prepared by incorporating extracted oil and cow milk (100% cow milk ice-cream, 50% Extracted oil 50% cow milk ice-cream, 75% Extracted oil 25% cow milk ice cream, 25% Extracted oil and 75% cow milk ice-cream). Ice cream containing 25% of oil extracted from marigold flower was the best one for ice cream mix for all functional properties with high quality and acceptable sensory properties.

Keywords: Bioactive compounds, marigold flower, carotenoid, ice cream, cow milk

1. Introduction
According to the Food Safety and Standards Authority of India (FSSAI), the term milk is defined as the-the normal mammary secretion derived from complete milking of healthy milch animal, unless otherwise specified in these standards, it must be free of colostrum and may not be added to or extracted from it. Cow's milk has been wide consumed round the world for many centuries and acts as a crucial supply of super molecule. It additionally acts as a wholesome complete food providing all the most important nutrients like fat, carbohydrates and proteins. Further, researchers have shown that the consumption of bovine milk will facilitate the body by providing big variety of host defense proteins (Hettinga *et al*. 2011; van Neerven *et al*. 2012) [11, 25]. This can be as a result of varied useful anti-microbial effects square measure determined in each human and bovine milks.
The consumption of cow's milk is related to overall diet quality and adequate intake of nutrients together with potassium, protein, iron, riboflavin, vitamin A, vitamin D, vitamin B and essential amino acids. A One such major purposeful demand is milk alternatives answer to issues of cow milk allergic reaction, genetic abnormality, calorie concern and prevalence of symptom (Valencia-Flores *et al*. 2013) [24].
Flowers are among the plant components that have been consumed as part of the human diet for thousands of years. Edible flowers were described in ancient manuscripts from all over the world, including Asia, Greece, and Rome, as well as mediaeval France, Europe, Victorian England, and the Middle East, with the assumption that they had therapeutic characteristics that would benefit people. However, their nutraceutical research has just lately begun. As a result, edible flowers have become increasingly popular in recent years. Edible flowers are in tremendous demand right now, as seen by the vast number of cookbooks, magazine articles, research studies, and television programmes dedicated to them. (Mlcek & Rop, 2011) [17]. The brilliant colours of edible flowers not only provide a distinct aroma, delicate flavour, and freshness to dishes, but they also have a high antioxidant level and activity, which is beneficial to human health.
Carotenoids such as lutein, -carotene, lycopene and zeaxanthin are abundant in marigold petals (Bolanos, Cruz, Islas, Alvarez, & Ramiro, 2005; Siriamornpun, Kaisoon, & Meeso, 2012) [4, 19]. Drying slows enzyme and microorganism-induced deterioration; it is the most common way of preparing and preserving edible flowers to lengthen shelf life. Traditional flower drying methods include sun drying, sunlight drying and shadow drying (Dilta, Sharma, Baweja &

Kashyap, 2011) [7]. Hot air drying, microwave drying, freeze drying, and vacuum drying are some of the modern drying methods. (Ding, You, An, Li, & Wang, 2012) [8]. Microwave-vacuum drying, vacuum and microwave-assisted infrared radiation pulse-spouted bed freeze-drying, and microwave freeze drying have all been investigated in various fruits and vegetable products and might be potential technology for drying marigold blooms (Cao, Zhang, & Mujumdar, 2018) [5].

Over the past twenty years, ice cream technology has improved considerably and food technology consultants have added new or purposeful food additives to ice cream to work out the interactions occurring in it (Soukoulis *et al*., 2014) [20]. Milk and milk products have a high nutritional value and they are also rich in protein and calcium content. Ice cream is a popular frozen dessert and it is vital to extend the quality and functionality of dairy products by offering them to the taste of consumers.

Ice cream is a frozen food product ready from cow or buffalo milk or the mix thereof, with the addition of ingredients like sweetener, emulsifier, stabilizer, color, and flavor with the incorporation of air and chilling the combo. Frozen dessert trade may be a profitable trade because of its increasing demand in market and also the recent advances (Mangsi *et al*., 2011) [16]. Ice cream created commercially is poor within the natural antioxidants like ascorbic acid, colours and polyphenols. Thus, it's of concern to explore the probabilities of the development of the nutritive worth of the frozen dessert with the utilization of various ingredients like fruits wealthy in antioxidants, dietary fiber, vitamins and minerals (Waterhouse *et al*., 2013) [22].

2. Research Methodology

A. Materials and Methods

Marigold flower (orange variety of 5 kg) was purchased from local market in Ludhiana city, Punjab. The marigold flowers were dried in the shade for 3-4 days and it was made into powdered form with aid of pestle and motor and was stored in zip lock pouch at room temperature for further analysis. All chemicals and reagents used in the study were of analytical grade and were procured from standard manufacturer.

Fig 1: Freshly plucked marigold flowers

Fig 2: Dried Marigold petal powder

B. Extraction of oil

Take 0.95 g of the powdered sample to that add 9.05 g of refined oil in a conical flask and keep it in water bath at 65 °C for 12, 30, 60, 90, 120, 240 and 270 minutes and in microwave oven respectively. Then it is centrifuged at 6000 rpm for 10 minutes and sediment is left off and the oil was and stored in culture bottle at room temperature for further analysis (Aysel *et al*., 2020) [9].

Fig 3: Beta carotene extracted oil

C. Preparation of ice cream

Four variant of ice creams were prepared by incorporating extracted oil and cow milk (100%cow milk ice-cream, 50% Extracted oil 50% cow milk ice-cream, 75% Extracted oil 25% cow milk ice cream, 25% Extracted oil % and 75% cow milk ice-cream).

The calculated amount of milk was added to the dry blend all the solid ingredients were weighed and mixed together with extracted oil till it dissolves. The mix was first pre heated at 40-45 °C for few minutes and continue blending the mixture at 65-75 °C. The mixtures were pasteurized at 85 °C for 15secs, then it was allowed to cool down at room temperature, subsequently the mixture was homogenized rapidly to incorporate air and to avoid clumps. The blend was stored at 4±1 °C for 12 hours ageing, then followed by addition of 3 drops of liquid vanilla flavour into the mixture. The mixes were poured into plastic cups and -23 °C for hardening and stored.

Fig 4: Mixing of liquid ingredients (milk and extracted oil)

Fig 5: Blending of milk and extracted oil

Fig 6: Ice cream

2.1 Determination of total solids content

Total solids content of cow milk and ice cream samples were determined according to the modified method of AOAC (2005) [2].

2 g of each sample were put in a clean, dry aluminium dish with a level bottom. The plates were cooked for 10-15 minutes in a steam bath before being placed in an air oven for 12 hours at 50 °C. The dishes were then weighed after cooling in a desiccator. The process of heating, chilling, and weighting was repeated until the difference between two weightings was less than 0.5 mg. The following formula was used to get the total solids content:

$$Total\ solids\ (\%) = (W1/W0) * 100$$

Where:
W1-Weight of sample after drying.
W0-Weight of sample before drying.

2.2 Determination of moisture content

The moisture content of soy bean was determined according to standard methods of association of official analytical chemists (AOAC, 2005) [2].

The moisture content is determined by heating a weighted sample at 105 °C in an oven under air pressure. The weight difference before and after drying is then computed as a percentage of the original weight. A 5g (1mg) sample was weighed onto a dry and tarred plate. The sample was then placed in an oven (NO.03-822, fn400, turkey) at 105 °C until it reached a consistent weight. The cover sample was then placed in desiccators and allowed to cool to ambient temperature before being reweighed. For each sample, three duplicate findings were collected and the mean value was given.

Where:
M1- Weight dish + cover.
M2- Weight of dish + cover + sample before drying.
M3- Weight of dish + cover + sample after drying.

The dry matter (DM) percentage was calculated by subtracting the percentage of moisture from 100%.

2.3 Determination of ash content:

The ash content was determined according to AOAC (2005) [2].

On a steam bath, 2 g of samples were weighted into an appropriate clean dry crucible and evaporated to dryness. The crucibles were heated to 550 °C in a muffle furnace for 1.5-2 hours, then cooled in a desiccator before being weighted. The ash content was calculated as follows:

$$Ash\% = (W1/W0) * 100$$

Where:
W1 - Weight of ash.
W0 - Weight of sample.

2.4 Determination of pH Value

The pH value of samples was determined with a pH meter (S20 Seven Easy TM pH, Metter Toledo, Columbus, OH) accordance with (AOAC, 2005) [2].

Cow milk samples were kept in room temperature. The ice cream mixes were stored in -4 °C overnight, and measured at room temperature.

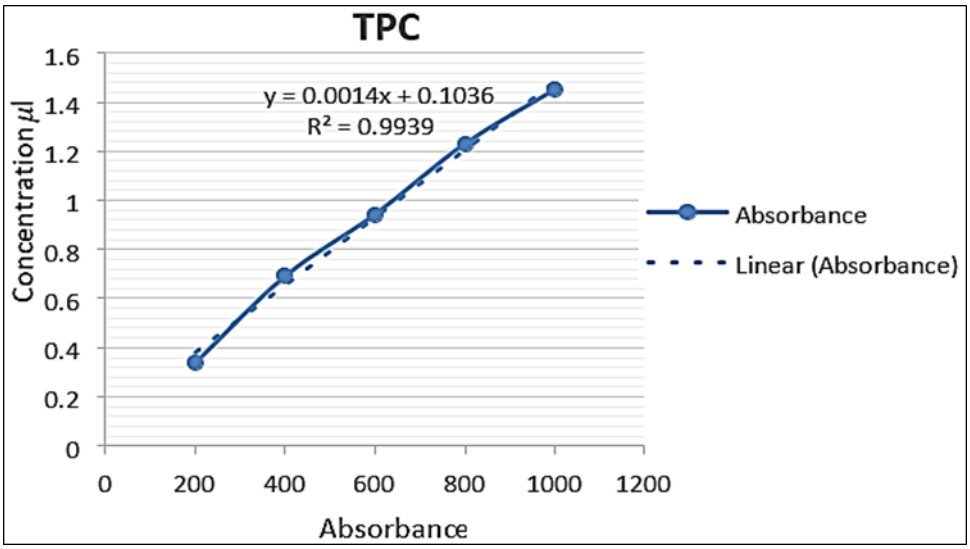
2.5 Determination of viscosity value

After a period of ageing (for 8 hours at 4 °C), measurements of ice cream samples filled in 180 ml containers (6 cm diameter x 9 cm height) were taken with spindle number 4 at 42 rpm, at 141 ºC and at a time of 45 seconds in three replications. with a Brookfield viscometer and viscosity was reported based on Cent i-Poise (cp) (model DV-II + Pro, India) (Akesowan, *et al*., 2009) [1].

2.6 Total phenolic content

The method used for the sample extract preparation was adopted from procedure given by Goraya and Bajwa, (2015) [10].

The sample was made by combining 2 g of material with 25 mL of 80% methanol solution and allowing the extraction to stand for 1 hour. The material was filtered using Whatman filter paper no. 1 and methanol was used to dilute it to 100 ml. Based on the technique employed with certain adjustments, the phenolic content was evaluated using Folin-Ciocalteu reagent. 1 mL Folin-Ciocalteu reagent was combined with 0.1 mL sample extract (1:9 parts of Folin-Ciocalteu reagent to distilled water). After a 5-minute delay, 1 mL sodium carbonate was added, and the volume was increased to 10 mL with distilled water. The reaction mixture was maintained at room temperature for 90 minutes before being analysed using a spectrophotometer at 725 nm. The standard was gallic acid, which was measured in mg gallic acid equivalent (GAE) per gram of material.

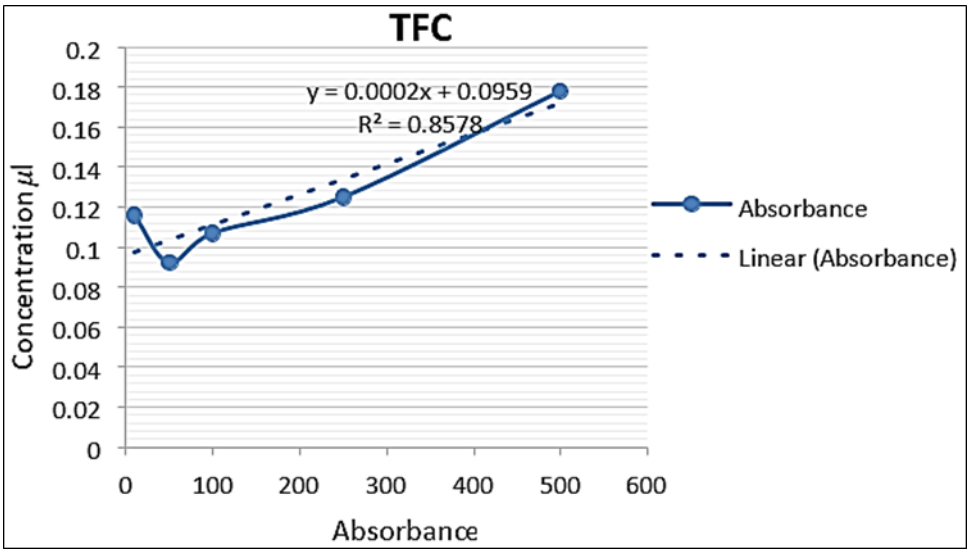


Total phenolic content

2.7 Total flavonoid content

Total flavonoid content was determined using AlCl3 method as given by (Jagadish *et al*., 2009) [12] with slight modifications.

1 mL methanolic sample extract was combined with 5 mL distilled water and 0.3 mL sodium nitrite (5% $NaNO_2$) in a mixture. After allowing the mixture to sit at room temperature for 5 minutes, 1.5 mL Aluminium trichloride (2 percent AlCl3) was added. After 6 minutes of incubation, 0.2 mL sodium hydroxide (1M NaOH) was added to the mixture. After 5 minutes, the mixture was tested for absorbance at 510 nm using methanol as a blank. The standard was quercetin, which was measured in mg quercetin (QE) per gramme of material.



Total flavonoid content

2.8 Total antioxidant activity

Antioxidant activity (Free radical scavenging activity) was measured as per the method of Ali, M. N. *et al*., (2013) [21]

The free radical source was DPPH (2,2-diphenyl-1-picrylhydrazyl). The reduction in absorbance was measured at 515 nm for 30 minutes just until the absorbance became constant, using 3.9 mL of 6x10-5 mol/L DPPH in methanol in a cuvette with 0.1 mL of sample extract. As a control, methanol was employed. Using the following equation, the residual DPPH concentration was calculated:

$$Antioxidant\ activity\ (\%) = (B) — Ab(S) \times 100\ Ab\ (B)$$

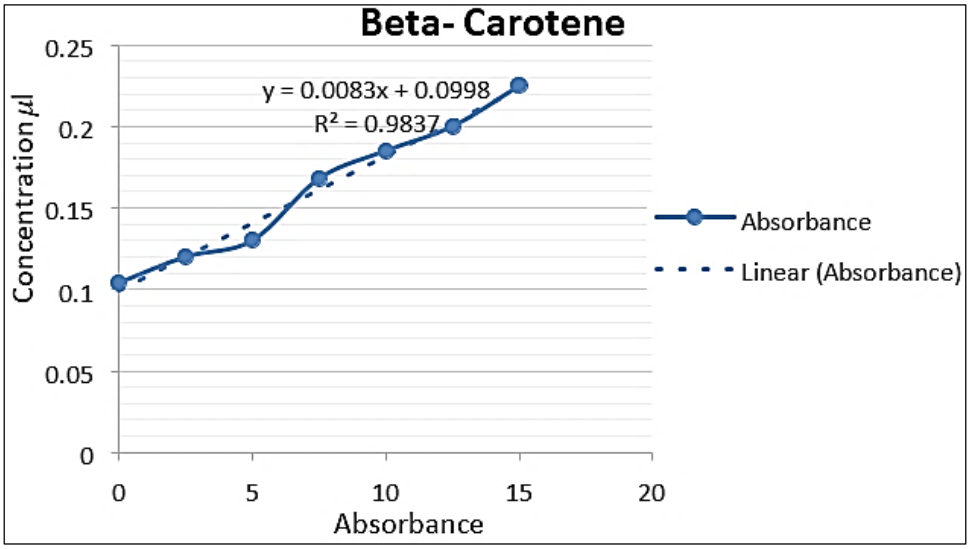
Where,

Absorbance (B) = Absorbance of blank.

Absorbance (S) = Absorbance of sample.

2.9 Beta-Carotene content

Weigh accurately 25 mg of β carotene. Dissolve in 2.5 ml of chloroform and make up to 250 ml with petroleum ether. Dilute 10 ml of this solution to 100 ml with petroleum ether. Pipette 5, 10, 15, 20, 25 and 30 ml of the solution to separate 100ml volumetric flasks, each containing 3 ml of acetone. Dilute to mark with petroleum ether. The concentration will be 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 µg per ml. Measure the colour at 452 nm using 3% acetone in petroleum ether as blank. Plot absorbance against concentration (Kemmerer., *et al*. 1943) [13].



Beta-Carotene content

3. Sensory evaluation

Sensory evaluation was done as described according to Clarke (2004) [6]. Using the hedonic scoring test method. In this method 25 trained panellist from the industrial Research and consultancy centre. Panellists were asked to evaluate the products with regard of their Taste, colour, flavour, texture and overall acceptability colour, using the following hedonic scale: 5= excellent, 4= very good, 3= good, 2= acceptable, 1= unacceptable.

Statistical analysis

Results are expressed as mean value ± standard deviations (S.D) of three replicates. A one-way ANOVA analysis was applied to the obtained data, as well as Duncan's multiple range test in order to establish the statistical significance of difference. Significance was tested at a 5% level. Statistical analyses of the data were performed with the SPSS statistical software package (version 16; SPSS Inc; India).

3. Result and Discussion

The results of the physio-chemical properties of marigold petal powder and the oil extracted from it and ice cream.

The marigold flower petal powder had undergone tests like total phenolic content, flavonoid content, antioxidant activity and beta carotene content.

The results revealed that the petal powder contains Total phenolic content of 1000.35±0.0986 mg GAE/100 g, Total flavonoid content of 3426.33±0.5033 mg QE/100 g, Beta-Carotene content of 30.7933±0.1006 mg/100 g and Total antioxidant activity of160.03±0.1868 μg and yield of β carotene per 100g contains 4.34 g.

Table 1: Functional properties of marigold flower

Constituents				
Sample	**Total Phenolic compounds as Gallic acid mg/100g**	**Total Flavonoids (mgQAE/100g)**	**Antioxidant activity % as DPPH**	**β- Carotene mg/100g**
Marigold petal powder	1000.35±0.0986	3426.33±0.5033	160.03±0.1868	30.7933±0.1006

Proximate Analysis of marigold petal

The moisture content in marigold petal was 82.21±0.02 because fresh marigold petals contain a large quantity of water (88%), lowering the water content is critical for extending storage duration, delaying deterioration, and preventing colour degradation. Avoiding UV irradiation, oxygen, pH changes, and high temperature treatment is crucial for pigment retention. (Kurniawan *et al*., 2017) [14]. The ash content was determined to be 1.23±0.01 and fat content was 0.35±0.02. These findings are comparable to those of Navarro González *et al*. (2015) [18].

Table 2: Physio chemical tests in marigold flower

Parameters	Marigold petal Powder
Moisture (%)	82.21±0.02
Ash (%)	1.23±0.01
Fat (%)	0.35±0.02

Identification of carotenoids extracted from marigold flower using conventional method and microwave assisted method.

Identification of carotenoids extracted from marigold flower was done by conventional method. The carotenoids extracted from marigold flower used refined oil by conventional method. The mixture was heated at 65C in water bath for 270 minutes. The samples were taken out at 12, 30, 60, 90, 120, 180, 240, 270 minutes interval and carotenoid content of the samples were obtained. The total phenolic content of 800 mg GAE/100 g, total flavonoid content of 488.2 mg QE/100 g, beta-carotene content of 25.6 mg/100 g and total antioxidant activity of 121%. This method revealed that yield of g of β carotene per 100g contains 3.68 g.

Table 3: Conventional Method

Sl. No.	Time (minutes)	Flavonoid Test (mg QAE/100g)	Phenolic Test (mg GAE/100g)	Beta- Carotene Test (mg/100g)	Antioxidant test (%)
1.	12	483.32±0.5143[a]	800.48±0.5632[a]	25.65±0.556[a]	121.71±0.4257[a]
2.	30	392.22±0.2193[b]	750.54±0.5786[b]	21.33±0.404[b]	89.63±0.4731[b]
3.	60	365.39±0.5522[c]	704.22±0.2610[c]	19.39±0.467[c]	75.34±0.3504[c]
4.	90	287.51±0.5597[d]	603.8±0.4582[d]	16.24±0.272[d]	66.61±0.4517[d]
5.	120	222.18±0.4517[e]	570.22±0.4495[e]	14.50±0.54[e]	57.77±0.4188[e]
6.	180	180.78±0.3868[f]	490.03±0.2516[f]	11.67±0.497[f]	41.58±0.4229[f]
7.	240	102.4±0.4784[g]	416.43±0.5859[g]	9.36±0.463[g]	28.47±0.4689[g]
8.	270	80.67±0.395[h]	300.23±0.4932[h]	5.16±0.292[h]	22.68±0.3037[h]

Means in the same row with the same superscript are not significantly different (p<0.05).

Identification of carotenoids extracted from marigold flower was done by microwave assisted method. The carotenoids extracted from marigold flower used refined oil by microwave assisted method. The mixture was heated at 65C in microwave for 270 minutes. The samples were taken out at 12, 30, 60, 90, 120, 180, 240, 270 minutes and carotenoid content of the samples were obtained. The total phenolic content of 625 mg GAE/100g, total flavonoid content of 376.0 mg QE/100 g, beta-carotene content of 20.85 mg/100 g and total antioxidant activity of 119%. Yield of μg of β carotene per 100 g contains 3.56 g. Carotenoids, including lutein, include trans isomers in their double bonds, which may be found in a variety of foods. During heat exposure, these trans double bonds are partly converted into the cis form, which is thermodynamically less stable than the trans isomer. This might account for the reduced concentration of lutein recovered from flowers dried at oven temperatures compared to other drying processes. The current study's oven drying procedure offers little potential for conserving lutein during drying.

Table 4: Microwave Method

Sl. No.	Time (minutes)	Flavonoid Test (mg QAE/100g)	Phenolic Test (mg GAE/100g)	Beta-Carotene Test (mg/100g)	Antioxidant test (%)
1.	12	375.95±0.07[a]	624.86±0.07[a]	20.79±0.06[a]	118.8±0.22[a]
2.	30	304.52±0.39[b]	526.36±0.21[b]	19.48±0.40[b]	91.56±0.09[b]
3.	60	285.23±0.11[c]	514.32±0.20[c]	17.8±0.02[c]	78.9±0.22[c]
4.	90	227.32±0.19[d]	409.87±0.10[d]	15.74±0.03[d]	67.84±0.16[d]
5.	120	202.3±18[e]	380.31±0.17[e]	13.9±0.04[e]	52.37±0.11[e]
6.	180	150.53±0.18[f]	257.03±0.08[f]	9.99±0.19[f]	45.6±0.19[f]
7.	240	26.34±0.13[g]	209.55±0.05[g]	8.64±0.03[g]	32.63±0.14[g]
8.	270	90.84±0.15[h]	190.54±0.14[h]	6.51±0.16[h]	25.31±0.16[h]

Means in the same row with the same superscript are not significantly different (p<0.05).

Comparison of effect of time exposed to heat on β-carotene extracted oil at 65 °C.

The foremost origin of carotenoids degradation in foods is oxidation. The oxidation mechanism in processed foods was a complex process that was influenced by a number of factors. Light, heat, and the presence of pro and antioxidants influence the rate at which pigments autoxidize by reacting with ambient oxygen. Isomerization was also aided by light, heat, and acids. There was no degradation and also similar stability was observed as a result of exposing carotenoid at moderate time 12 minutes at 65 ºC in both microwave and conventional methods, while at time above 12 minutes, the degradation of carotenoid increased gradually by increasing the temperature.

For instance, the degradation of carotenoid, caused by its exposing to 30, 60, 90, 120, 240 and 270 minutes. The highest degradation of carotenoids extracted from marigold flower was observed at 270 followed by 240, 120, 90, 60 and 30 C, respectively. Therefore, the carotenoids from marigold flowers were more heat stable with lower degradation rate was noticed at 65 ºC for 12 minutes in conventional and microwave techniques. But the conventional method shows more content of beta carotene than microwave method due to the degradation of foods. These conclusions were supported by Shi *et al*. (2002) [15].

Proximate Analysis of ice cream samples from blend of cow milk and extracted oil

The result in Table 5 shows the proximate composition of the ice cream samples formulated through the blend of cow milk and extracted oil at different ratios to give four ice cream samples.

Moisture content

The percentage moisture content (%MC) for ice cream samples A, B, C and D were 86.60±0.02, 86.08±0.07, 85.81±0.08 and 85.44±0.09 respectively (Table no. 5). The moisture content of all the samples were significantly different at p<0.05. The moisture content was high in Control (A). This implied that the cow milk contributed more to the moisture content of the ice cream samples than the extracted oil with respect to the recipe used. This was because milk is high in moisture content with value of 88%. According to Goff (2008) the moisture content of ice cream ranged between 55%-64% which comes from the milk or other ingredients.

Ash content

The ash content of the ice cream samples ranged from 1.97±0.06 to 2.8±0.01. The ash contents were not significantly different at p<0.05 for all the samples. Sample A (100% cow milk ice cream) had the highest ash content of 2.8±0.01 while the least was sample D (75% extracted oil milk ice cream). The value of ash content decreased as the quantity of extracted oil blended with cow milk increased. This implies that cow milk ice cream had more ash content than extracted oil milk ice cream. Ash content is an indication of mineral content of the ice cream samples.

Table 5: Proximate Analysis of ice cream

Parameters	Control (Sample A) Sample B	Sample C	Sample D
Moisture	86.60±0.02[a] 86.08±0.07[b]	85.81±0.08[c]	85.44±0.09[d]
Ash	2.8±0.01[a] 2.39±0.01[b]	2.17±0.06[c]	1.97±0.06[d]

Means in the same row with the same superscript are not significantly different (p<0.05).

Physicochemical properties of the ice cream produced from blend of cow milk and extracted oil pH

The physicochemical composition of ice cream produced from the blend of cow milk and extracted oil (Table 6). The pH values for all the samples ranged from 6.01 to 6.63. The pH of all the samples were near neutral pH and since lower pH (acidic) in foods helps to reduce the activity of spoilage microorganism it implies that all the ice cream samples may have low shelf stability. Thus, there was need for cold storage in order to extend its shelf stability with a highly significance (p<0.05) (Uzoukwu, 20114) [23].

Total Solids

The total solids for the ice cream samples ranged from 32.14±0.20 and 32.54±0.27. The value of % total solids increased (p<0.05) in all the samples as the proportion of cow milk added increased. Insufficient total solids in ice cream results to poor textural quality such as coarse texture, weak body etc. (Uzoukwu, 2014) [23].

Viscosity

The viscosity for the ice cream samples ranged from 108.22±0.01 and 108.24±0.02. The viscosity increases (p<0.05) as the quantity of percentage of oil addition has been increased (Uzoukwu, 2014) [23].

Table 6: Physio chemical properties of ice cream

Parameters	Control (Sample A)	Sample B	Sample C	Sample D
Ph	6.63±0.52	6.48±0.41	6.31±0.36	6.01±0.62
Total Solids	32.14±0.20	32.34±0.35	32.44±0.46	32.54±0.27
Viscosity	108.23±0.01	108.22±0.02	10.22±0.01	108.24±0.02

Sensory evaluations

The results of the Sensory evaluations of ice cream prepared with different ratios of oil extracted from marigold flower samples were summarized (Figure no. 7 & 8). The aforementioned data indicated that, the ice cream prepared with 25% of oil extracted from marigold flower (Sample B) recorded the highest total score for all tested parameters (P<0.05) followed by 0%, 50% and 75% for ice cream with oil extracted from marigold flower. This summarizes that, adding 25% of oil extracted from marigold flower to ice cream mix improved the whole parameter of sensory properties of ice cream, but addition of oil extracted from marigold flower at ratios higher than 25% caused to lowering the score for flavour, texture and mouthfeel. Finally, ice cream containing 25% of oil extracted from marigold flower was the best one for ice cream mix for all functional properties with high quality and acceptable sensory properties. These results were confirmed with Bahram Parvar *et al*. (2010) [3].

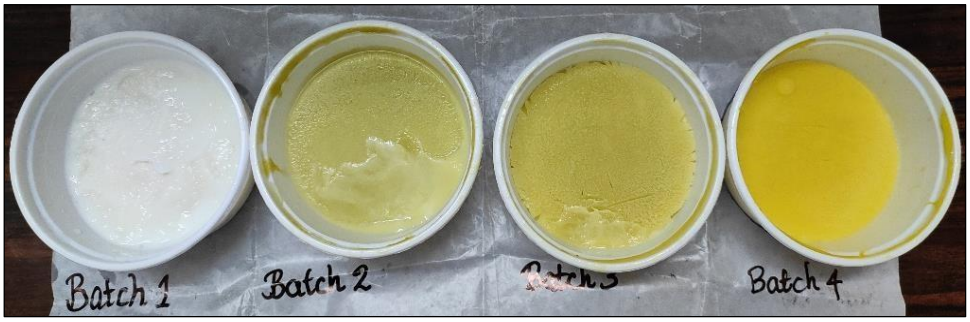


Fig 7: Batches of ice cream

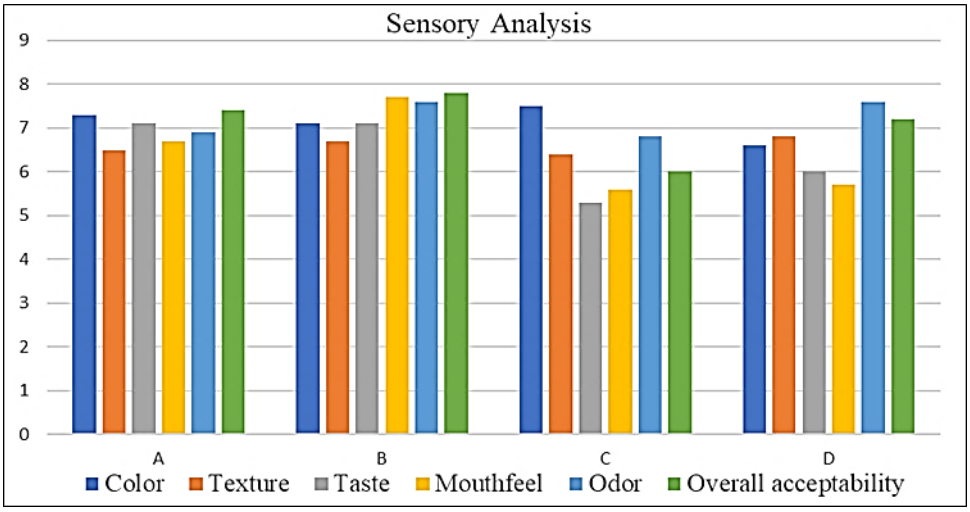


Fig 8: Sensory Evaluation of Ice cream

4. Conclusion

In conclusion an ice cream with acceptable sensory attributes like taste, colour, flavour and consistency (mouth feel) could be produced from blend of cow milk and extracted oil at 25% level of substitution of cow milk with extracted oil. In addition, considering the nutritive and health benefit of beta carotene which is underutilized, its incorporation in ice cream has increased its utilization and nutritional quality derived from it. Enrichment of ice cream with oil extract from marigold flower imparted a more appealing colour and showed a higher content of total phenolic compounds, total flavonoid content and antioxidant activity. The formulations with the edible flower showed good potential as a healthy frozen dessert and could add a unique characteristic to the ice cream. However, the consumer acceptability of edible flower ice cream could be further enhanced. Because of the carotenoid concentration, marigold flower petals may be acceptable for use as a food colouring agent as well as a vitamin supplement, according to the study. The antioxidant qualities of carotenoids make the use of marigold flower as a functional food component even more enticing, indicating that carotenoid utilization has a lot of promise.

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