

SUMMARY & CONCLUSIONS

In recent years, consumers have directed their interest towards reduced or low fat products as they associated them with a reduced risk of obesity and coronary heart diseases. Owing to the important and key role of fat in improving the texture and flavour of ice cream, removal or reduction of its fat content causes many defects in the quality of their products. To solve this health problem, fat replacers can be added to the mix. Low sugar or free sugar dairy products represent on other important category of functional products, needed by those suffering from diabetes and obesity and those watching their weight. The use of artificial sweeteners in food is very useful as it imparts sweetness without adding sugar which result in caloric reduction, helps in weight loss and diet control. Artificial sweeteners are considered safe as some of them not digested by our body like sucralose.

Therefore, this study was carried out in three parts.

Part I

"Improving the quality of low- fat ice cream using selected fat Replacers".

The aim of this part was to produce low fat ice cream (2%) and incorporating fat replacers to improve the quality of the resultant ice cream.

The treatments used were:

C1: control 6% fat

C2: control 2% fat

T1: 2% fat + 2% inulin

T2: 2% fat + 2% maltodextrin

T3: 2% fat + 2% modified starch

T4: 2% fat + 2% WPC

T5: 2% fat + 2% oat

The ice cream mixes and the resultant ice creams were analysed and the data can be summarised as follows:

- 1- Total solid was the highest in C1 and the lowest in C2 but the other treatments were non-significant.
- 2- Fat content was the highest in C1. The other treatments were almost the same as the fat content was adjusted to be 2% and the small differences between them was due to the differences in composition of the added fat replacers.
- 3- No great differences were observed between treatments in the protein and ash contents. Some differences are occurred due to the differences of the fat replacers.
- 4- The CHO% are calculated by the difference, so any difference in the components affects it.
- 5- The acidity % and pH value were almost the same and the differences were insignificant ranging between 0.17 to 0.18% and 6.73 to 6.82 respectively.
- 6- The specific gravity and weight/ gallon of the mix ranged 1.00 to 1.08 g/ml and 3.79 to 4.24 kg.
- 7- Freezing point ranged from -2.8 to -3.8°C. Removal of fat did not affect the freezing point. However, addition of fat replacers decreased the freezing point due to the soluble contents of them.
- 8- Results revealed that the lowest viscosity was for C2. Addition of fat replacers increased the viscosity of low-fat mixes with significantly various degrees according to the properties of the fat replacers added.

Regarding to the resultant ice cream:

- 9-The overrun of low fat (C2) ice cream was higher than that of full-fat (C1). Addition of fat replacers significantly affect the percentage of overrun according to its nature and composition.
- 10- The specific gravity of full fat ice cream (C1) had significantly higher value than low fat (C2) ice cream . Incorporating fat replacers to the low fat mixes gave different results of specific gravity according to its type and composition. The weight/ gallon of ice cream was closely related to the specific gravity of the ice cream.
- 11- The hardness of low-fat ice cream (C2) was significantly ($p < 0.05$) higher than the full fat ice cream. The addition of fat replacers affect the hardness according to the type and characterization of them.
- 12- Removal of fat influence the colour of ice cream. Also, addition of fat replacers affect on the colour of ice cream according to its types and properties.
- 13- As the fat content of an ice cream increases, its melting rate decreases. Therefore, less fat content was probably the main reason for the higher melting rate of the low-fat ice cream compared to that of the control ice cream (full fat). The overrun also affect on the melting resistance of ice cream. Incorporating fat replacers in mixes had various effects on the low-fat ice cream according to its types and properties.
- 14 - All ice cream samples gained higher organoleptic scores than the low-fat control (C2). A flavour was received in reduced fat ice cream. Addition of fat replacers improved the flavour and texture. The results revealed that maltodextrin (T2) scored closest to the

full-fat control (C1), then (T1) thereafter, generally in order T3, T4, T5 and at last, the low-fat ice cream (C2).

15 – The viable total bacterial count of all ice cream samples ranged from 3.10 to 3.36×10^3 cfu/g. The coliform bacteria was absent in all treatments, also psychrophilic bacteria was not detected in all treatments of ice cream as well as, the mould and yeast were absent.

16 – The highest caloric value of ice cream was recorded in C1 (168.95 kcal/100g), while (C2) the reduced fat ice cream was 134.33kcal /100g with a reduction of 20.49 %. There was no great differences among the another treatments containing fat replacers which is due to the composition of fat replacers.

Part II

"Production of low fat free sugar ice cream using intensive sweeteners (sucralose and stevia)".

In this part, sucralose and *Stevia rebaudiana* were used as sucrose substitute, polydextrose as a bulking agent and sorbitol to control the freezing point.

The suggested treatments were:

T1: control low fat (2% fat)

T2: control 2% fat + 2% maltodextrin

T3: 2% fat + 2% maltodextrin + sucralose

T4: 2% fat + 2% maltodextrin + sucralose + sorbitol

T5: 2% fat + 2% maltodextrin + stevia

T6: 2% fat + 2% maltodextrin + stevia + sorbitol

The ice cream mixes and resultant ice cream were analysed and the data can be summarised as follows:

- 1- There was no obvious differences in the chemical composition of all treatments except T1 as it was control without fat replacer and it was low in TS.
- 2- There was an increase in the acidity % when the sugar replaced by sucralose or stevia while there was no significance between the treatments. The pH value was ranged between 6.47 to 6.58.
- 3- Addition of fat replacer (maltodextrin) in T2 lower the freezing point. Adding bulking agents to free sugar treatments as polydextrose and sorbitol also lower the freezing point.
- 4- The specific gravity of the mix showed slight variations in the mixes and it was ranged between 1.10 to 1.16 gm/cm³. The corresponding values of weight/ gallon in ice cream mixes was clearly related to the specific gravity of the ice cream mixes.
- 5- The viscosity of control T1 was the minimum, while in the other experimental samples it varied between 1513.33 to 1626.66 Cp due to the addition of maltodextrin and polydextrose.
- 6- The overrun of the different treatments ranged between 24.82 to 39.28. The highest was for control T1, thereafter, come T2, then T4 and T3 and at last the stevia free sugar ice cream.
- 7- Specific gravity and weight/ gallon showed a slight low value between T1 and other treatments in the resultant ice cream.
- 8- The highest value of hardness was for T1 (control without any additions). Addition of maltodextrin as a fat replacer decreased the hardness in the low- fat free sugar. Replacing sugar with stevia affected the hardness of the ice cream and it was higher than the other low -fat free sugar ice creams.
- 9- The control T1 without any additives achieved the lowest degree in colour as it was low fat. Addition of fat replacer (maltodextrin)

raised the L^* value of all samples. Combination of polydextrose with maltodextrin as a bulking agent enhanced the colour of ice cream.

- 10 - At the first 15 min. the melting portion of T1 was higher than the other treatments, came after, T2 which containing maltodextrin and sucrose. Addition of polydextrose and sorbitol with the sugar substitutes decreased the melting resistance.
- 11 - The organoleptic scores revealed that T1 had the lowest scores. Addition of fat replacer to the other treatments improved the properties of ice cream. Using artificial sweeteners to low fat free sugar ice cream such as sucralose or stevia showed the possibility of producing high quality low fat free sugar ice cream which is low in caloric value, suitable for using in dietetic and diabetic healthy diets. We can arrange the treatments with a descending order as follows: T3 and T5 → T4 → T6 → T2 → T1.
- 12 - The TBC in the optimized low- fat free sugar ice cream was ranged 3.7 to 5.8×10^3 cfu/g. The coliform was nil and the psychrophilic bacteria were not detected as well as, the moulds and yeasts were absent.
- 13 - The caloric value of T2 was higher than T1 by 6.72% due to the addition of maltodextrin. Substitution of sugar by sucralose or stevia lowered the caloric value. The reduction in caloric value in treatments of T3, T4, T5 and T6 were 40.45, 35.57, 42.05 and 35.60% respectively.

Part III

"Production of low-fat labneh using exopolysaccharide producing LAB"

This part aimed to produce low-fat labneh and improved its quality by using EPS producing LAB as a starter.

The suggested treatments were:

C1: control full-fat labneh (3% fat) using traditional yoghurt starter 3%

C2: low-fat labneh (1.5% fat) using traditional yoghurt starter.

T1: control low-fat labneh (1.5% fat) using 1.5% traditional yoghurt starter + 1.5% *Lactobacillus plantarum* as EPS producing bacteria.

T2: control low-fat labneh (1.5% fat) using 1.5% traditional yoghurt starter + 1.5% *Streptococcus thermophilus* as EPS producing bacteria.

T3: control low-fat labneh (1.5% fat) using 1.5% traditional yoghurt starter + 1.5% *Lactobacillus plantarum* and *Streptococcus thermophilus* (1:1) as EPS producing bacteria.

The data can be summarised as follows:

- 1- Data clear that C1 had the lowest moisture content, while T1 containing EPS from *Lactobacillus plantarum* the highest moisture content. Cold storage slightly decrease the moisture that remaining T1 the highest due to EPS.
- 2- The protein content was the highest in full-fat (C1) when fresh, and decreased during storage due to break down of some proteins to with the other treatments.
- 3- The fat content was adjusted in full-fat and low-fat labneh. The differences in low-fat labneh do not exceed $\pm 0.1\%$.

- 4- No obvious trend was reported in the fresh labneh or during the storage Periods in ash content.
- 5- CHO of labneh when fresh ranged from 3.50 to 6.40% and it decreased during storage in all treatments. The lowest CHO was for full-fat labneh either fresh or at the end of storage.
- 6- Acidity% of fresh labneh ranged between 0.82 and 0.95%. It was increased in all treatments to reach 1% at the end of storage. The pH took the opposite trend.
- 7- The labneh made with EPS producing bacteria (T1) exhibited somewhat higher values of S.N than all treatments and controls, when fresh and through the storage period. The S.N/T.N took almost the same trend.
- 8- EPS content in labneh was the highest in T1 when fresh and all over the storage period; followed by T3, T2 and at last the controls.
- 9- The texture profile of fresh labneh was analysed for all the treatments.
- 10- Lactobacilli and LAB was increased till 21days of storage while Streptococci increased till 14 days only. Afterthat, the bacteria decreased till the end of storage period due to the increase of the acidity.
- 11- T1 gained the highest scoring points, followed by T3→T2→C1 and at last C2. EPS enhance water binding capacity and viscosity and improved the texture of labneh.

CONCLUSION

From the foregoing results, it could be concluded that it is possible to produce high quality low fat (2%) ice cream by addition of 2% fat replacer to the mix. Incorporating fat replacers possessed the most superior quality and had been liked all the panel members. Moreover, the results of this study confirmed the possibility of producing healthy, nutritious and improved low-fat ice cream. The best treatment was that containing maltodextrin as a fat replacer.

Based on the above results, it was also concluded the possibility of producing high quality low fat free sugar ice cream which is low in caloric value by about 35.5 to 42.0% by using sucralose or *Stevia rebaudiana* and polydextrose or polydextrose + sorbitol. This kind of ice cream is suitable also for using in diabetic diets because it does not raise the serum glucose in blood and does not create an insulin demand in diabetics. Polydextrose also is inert to the bacteria which fermenting sugars and producing the acids that leads to carious lesion in the teeth.