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THE EFFECTS OF DIFFERENT MILKPOWDER RATES, SUBSTITUTING SUBSTANCES AND STORAGE PERIOD ON PHYSICAL AND SENSORY PROPERTIES OF THE ENERGY REDUCED ICE CREAM *

Farklı Yağ Oranları, Tatlandırıcı Kombinasyonları ve Depolama Süresinin Enerjisi Azaltılmış Dondurmalarin Fiziksel ve Duyusal Özelliklerine Etkileri

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ABSTRACT

In this research 12 ice cream were produced by using 4 different rates of milkpowder (2, 4, 6, 8 %) and mixing maltodextrin (10 %), polydextrose (10 %) and equal amounts of these substances (5 % + 5 %) to each proyo. While the effects of using different rates of milkpowder on the volumatic increase, complete melting and viscosity values of the ice cream were found to be significant ($P<0.05$), it had no significant effect on the penetrometer, pH, first dripping and melting rate values ($P>0.05$). The most appropriate rate of milkpowder in the production of energy reduced ice cream was 6 %. It was found that using polydextrose, maltodextrin and equal amounts of these mixtures in the production of ice cream had a significant effect ($P<0.05$) on the overrun, penetrometer, first dripping, complete melting, melting rate and viscosity values of the samples. When the physical and sensory properties of the ice cream were taken into account it was determined that using equal amounts of maltodextrin and polydextrose was more appropriate. During the storage period of 3 months, all the physical and sensory properties ($P<0.05$) except the viscosity values of the ice cream had changed.

Key wods: ice cream, artificial sweeteners, maltodextrin, polydextrose.

ÖZET

Bu araştırmada 4 farklı süttozu grubu (% 2, 4, 6, 8) ile her gruba maltodekstrin (% 10), polidekstroz (% 10) ve bu maddelerin eşit oranlarda (% 5 + % 5) karıştırılmasıyla dondurma üretimi gerçekleştirilmiştir. Farklı oranlarda süt tozu kullanılmasının dondurmaların tamamen erime, hacim artışı ve viskozite değerleri üzerine etkisi önemli ($p<0.05$), pH, ilk damlama, erime oranı ve penetrometre değerleri üzerine etkisi önemsiz bulunmuştur ($p>0.05$). Çalışma sonucunda enerjisi azaltılmış dondurma üretimi için en uygun süttozu oranının % 6 olduğu belirlenmiştir.Dondurma üretiminde polidekstroz, maltodekstrin ve bunların eşit karışımının kullanılmasının örneklerin ilk damlama, tamamen erime, hacim artışı, viskozite, penetrometre ve erime oranı değerleri üzerine etkisi önemli bulunmuştur ($p<0.05$). Dondurmaların fiziksel ve duyusal özellikleri göz önüne alındığında maltodekstrin ve polidekstroz' un eşit oranlarda karıştırılarak

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kullanılmasının daha uygun olduğu belirlenmiştir. Dondurmaların 3 aylık depolama süresince viskozite ve asitlik değerleri hariç tüm özellikleri değişmiştir ($p<0.05$).
Anahtar Kelimeler: Dondurma, yapay tatlandırıcı, maltodekstrin, polidekstroz

Introduction

During the recent years great importance were given to the pharmacological effects of the foods and their components and several concepts such as healthy food, functional food, enriched food and diet food has arisen all around the world. In the industrialized communities these kinds of foods produced according to a target and on which intensive scientific and technological researches are conducted are consumed consciously (RANHOTRA at. all, 1993). Because of the increase in the demand of diet and low-calorie foods and in order to develop new supplements and new products in the food industry to meet these demands numerous researches are being conducted. Some of these researches are concerned with reducing the fat amount in the food by substituting fat – like substances and reducing the calorie value by new supplements. When the fat substituents are used in foods instead of the fats, the fat in the food can be reduced partially or completely and can reduce the energy resulting from the fat to a minimum level (ROTHWELL, 1997). The fat substituents such as maltodextrin and polydextrose can be used instead of the fat which effects both the structure and taste of the ice cream and can help to reduce the energy value of the ice cream (OHMES, at. all, 1998, ALEXANDER, 1998, KÜÇÜKÖNER and DOĞAN, 1999).

The maltodextrin is produced as a result of the fraqmentation of starch with enzyme and acid. The maltodextrin gel can easily combine with liquid and solid fats and from a stable emulsion gel. Since it gives the same taste as fat it helps the product to be easily broken into pieces in the mouth. It is most commonly used in margarine, mayonnaise, salad sauce, pastry and dairy products (ALEXANDER, 1998). Polydextrose is a glucose polymer which has an approximate molecule weight of 2000 and it can be used instead of the fat. In some products it is used in order to reduce the fat amount. Polydextrose which is a filling substance with low calorie can also be used as the substituent of sugar in the low calorie foods prepared with artificial sweeteners. Polydextrose which humidifies the products wich is added to and in some conditions gives taste, is used in the production of chocolate candy, cake, biscuit, frozeen dessert and microcrystal cellulose and diet dessert (KÜÇÜKÖNER, and DOĞAN, 1999). In the production of energy reduced ice cream usually inulin, oligofructose, polydextrose, isomalt, lactitol, maltodextrin, milk protein concentrates, rice starch, and artificial sweeteners are used as the substituents of fat and sugar and raw materials such as aspartame and asesulfam – K are used (ANONYMOUS, 2003).

The aim of this study is to determine the rate of the substituent substances, which are milkpowder, maltodextrin and polydextrose, appropriate for the low fat ice cream produced with artificial sweetteners. In addition to these, it is also aimed to

determine the possible physical and sensory changes in the shelf life of the energy reduced ice cream

Materials and Methods

The cow's milk which is the material of this research was provided from the Çukurova University, Faculty of Agriculture, Aplication Husbandry Stock-Breeding Department. The milk provided from the morning milking was brought to the Çukurova University Faculty of Agriculture Department of Food Engineering Milk Analysis and Research Laboratory and was applied to the ice cream. Other materials to be used in the research the sweeteners (Aspartame and Asesulfam – K) were provided from Marsa company, maltodextrin and polydextrose from Dalya Foreign Trade company, the nan fat milkpowder from Pınar company and the stabilizers (Sodium alginat and CMC) were provided from Panda company.

In the production of ice cream with in two weeks interval with two replicates, the cow's milk provided from the morning milking were divided into 12 groups with 3 kg each. Non fat milkpowder, polydextrose and maltodextrin rates given in Table 1 were added to each group. Then the ice cream mixes obtained from adding the stabilizers (0.5 %) were pasteurized at 90 ºC for 10 min, cooled to 45 – 50 ºC in a water pool and later sweeteners (2 unites of asesulfam – K mixtures to 8 unites of aspartame which is total 0.08 %) were added. The ice cream mixes were left to be ripened for 24 h at + 4 ºC. The freezing process was carried on for 10 min at – 15 ºC in the bacth type freezing machine. The ice cream produced were placed into concealed plastic pots which were 125 ml, stored for 3 months at – 25 ºC and during this period their physical and sensory properties were analysed.

Table 1. The ratios of same companents to be used in the ice cream production

Ice cream	Non Fat Milkpowder Rate (%)	Polidextrose Rate (%)	Maltodextrin Rate (%)
1	2	0	10
2	2	5	5
3	2	10	0
4	4	0	10
5	4	5	5
6	4	10	0
7	6	0	10
8	6	5	5
9	6	10	0
10	8	0	10
11	8	5	5
12	8	10	0

The acidity of the milk was determined according to the alkali titration method, the lactose was determined according to the Lane Eynon Method, the protein according to the microkjeldahl method (LİNG,1963) and the fat in the milk was determined according to the gerber method (ANONYMOUS., 1992). The volumatic increase in the ice cream was estimated and the penetrometer values were determined by using the Sur Berlin Type Penetrometer (KOÇAK, 1981), first dripping complete melting time and melting rates were determined (COTRELL at. all., 1979), the viscosity values were estimated according to the two headed capilar Oswald type viscosimeter and the sonsory properties were determined (ANONYMOUS., 1992). In the replicate trials variance analysis were used in order to evaluate the findings and the different groups were determined by the duncan test. The kruskal wallis test one of the non parametic test was used in the sensory analysis results, the differences between them were found (STEEL, and TORRİE, 1980).

Results

The cow's milk used in the ice cream production had a normal composition with pH value of 6.62 ± 0.017, titratable acidity % in terms of lactic acid of 0.169 ± 0.016 %, 11.53 ± 0.096 % dry matter, 3.20 ± 0.000 % fat, 3.75 ± 0.300 % protein and 4.10 ± 0.408 % lactose

As it can be seen in Table 2, using different rates of milkpowder has a significant effect ($p<0.05$) on the overrun of the ice cream. While using 2 and 4 % of milkpowder positively effected the overrun, using 6 and 8 % had a negative effect.

Using maltodextrin, polydextrose and equal combinations of these substances in the production of ice cream had a significant effect ($P<0.05$) on the overrun of the samples. Although the overrun values of the ice cream during the 3 months storage period were similar, the differences found between them were significant ($P<0.05$) according to the statistical analysis.

Table 2. The overrun values of the ice cream

Ice cream	1. day	1.month	2.month	3.month
1	29.50±1.73 [a*]	27.75±2.22 [b]	29.50±1.29 [a]	29.25±0.96 [a]
2	30.50±1.29 [a]	26.75±2.36 [b]	30.25±1.50 [a]	27.75±1.71 [b]
3	36.00±1.15 [a]	35.00±4.97 [b]	35.25±2.63 [b]	35.00±1.63 [b]
4	30.00±3.56 [a]	26.50±1.73 [b]	27.00±1.63 [b]	26.50±1.00 [b]
5	33.25±3.86 [a]	31.00±4.69 [b]	33.25±2.22 [a]	33.50±1.00 [a]
6	35.00±1.63 [a]	34.25±7.89 [b]	34.50±3.42 [b]	34.00±2.16 [b]
7	29.75±4.92 [a]	29.00±4.32 [a]	26.00±6.78 [b]	29.00±2.58 [a]
8	26.25±6.29 [a]	29.25±1.71 [b]	25.00±7.16 [a]	28.50±3.70 [ab]
9	31.00±2.45 [a]	31.25±1.50 [a]	30.00±4.08 [b]	31.50±1.73 [a]
10	29.75±3.20 [a]	23.50±3.51 [b]	21.00±1.41 [b]	23.50±1.29 [b]
11	29.00±2.83 [a]	22.00±7.02 [b]	19.50±2.52 [b]	21.50±2.89 [b]
12	32.50±2.65 [a]	31.50±7.72 [a]	32.00±2.58 [a]	32.25±2.75 [a]

* The mean values that include the same letter from left to right are not statistically different (P<0.05).

The effects of maltodextrin, polydextrose and equal combinations of these substances on penetrometer value of the ice cream were found to be signicant (P<0.05), while using different rates of milkpowder had no significant effect (P>0.05) on the penetrometer value of the ice cream (Table 3). The decrease in the penetrometer values of the ice cream during the storage period were also found to be statistically significant (P<0.05).

Table 3. The penetrometer values of the ice cream (mm x 10^{-1})

Ice cream	1. day	1.month	2.month	3.month
1	20.00±0.82 [a*]	20.50±1.29 [a]	13.25±1.26 [b]	13.00±0.82 [b]
2	19.25±0.96 [a]	21.25±1.26 [a]	14.25±0.96 [b]	13.00±0.82 [b]
3	21.25±2.75 [a]	24.75±1.26 [a]	15.50±1.00 [b]	14.00±0.82 [b]
4	17.75±1.71 [ab]	21.50±1.29 [a]	12.75±0.96 [b]	13.00±0.82 [b]
5	23.25±1.71 [a]	22.00±1.15 [a]	13.50±0.58 [b]	13.50±0.58 [b]
6	23.50±2.38 [a]	27.50±2.08 [a]	14.25±1.26 [b]	14.75±0.96 [b]
7	23.00±0.82 [a]	20.50±1.00 [ab]	15.00±1.83 [b]	15.00±1.83 [b]
8	23.25±1.50 [a]	22.50±2.38 [a]	13.50±1.29 [b]	12.50±0.58 [b]
9	25.00±1.41 [a]	27.75±1.71 [a]	15.75±0.96 [b]	16.00±0.82 [b]
10	21.00±1.15 [a]	21.00±1.15 [a]	16.00±1.83 [b]	13.00±0.82 [b]
11	22.75±1.71 [a]	24.50±0.58 [a]	13.50±0.58 [b]	14.00±0.82 [b]
12	23.50±2.65 [a]	24.25±1.50 [a]	14.00±0.82 [b]	15.00±0.00 [b]

It was found that using different rates of milkpowder, maltodextrin and polydexrose in the production of ice cream had a significant effect (P<0.05) on the first dripping time (Table 4). During the 3 months storage period there was an

increase in the first dripping time of the first dripping ice cream and this increase was found to be significant (P<0.05) according to the statistical analysis.

Table 4. The first dripping time of the ice cream (sec.)

Ice cream	1. day	1.month	2.month	3.month
1	912.00±47.88 [a*]	880.30±22.40 [b]	1046.30±21.40 [c]	1018.00±23.10 [d]
2	854.50±40.05 [a]	888.80±37.20 [b]	1051.80±37.30 [c]	1009.00±8.40 [d]
3	646.30±28.98 [a]	627.30±33.50 [b]	812.50±33.60 [c]	790.50±69.30 [d]
4	905.00±35.36 [a]	927.00±50.50 [b]	1100.00±31.00 [c]	1006.00±16.20 [d]
5	622.25±14.31 [a]	677.80±41.00 [b]	944.80±111.10 [c]	820.80±122.10 [d]
6	589.25±15.78 [a]	637.30±32.00 [b]	891.80±13.00 [c]	751.00±138.30 [d]
7	1020.80±20.22 [a]	1008.30±6.50 [b]	1075.80±35.00 [c]	1026.30±14.20 [d]
8	693.00±53.12 [a]	625.50±55.60 [b]	820.00±13.00 [c]	750.50±2.50 [d]
9	582.50±15.09 [a]	622.80±27.20 [b]	811.00±114.70 [c]	716.80±4.40 [d]
10	863.75±58.15 [a]	1020.80±34.40 [b]	1132.00±40.60 [c]	1051.80±44.10 [d]
11	770.50±64.46 [a]	892.30±45.20 [b]	1104.80±47.90 [c]	1042.50±104.00 [d]
12	592.00±8.21 [a]	608.30±15.80 [b]	839.00±105.90 [c]	816.30±128.60 [d]

In samples 1 and 2 to which 2 % milkpowder was added and in samples 10 and 11 to which 8 % milkpowder was added no complete melting was observed (Table 5).

Table 5. The complete melting time of the ice cream (sec.)

Ice cream	1. day	1.month	2.month	3.month
1	3560.3±56.6 [a*]	3619.3±9.6 [a]	0.0±0.0 [b]	0.0±0.0 [b]
2	3242.5±55.6 [a]	3337.5±17.9 [a]	5155.5±7.1 [b]	0.0±0.0 [b]
3	2802.3±60.9 [a]	2866.0±34.8 [a]	3080.3±20.50 [b]	3078.5±10.2 [b]
4	3994.8±84.9 [a]	3986.3±69.5 [a]	5117.0±12.7 [b]	4754.3±134.9 [b]
5	3435.5±48.3 [a]	3395.5±52.3 [a]	4008.0±203.6 [b]	3926.5±223.7 [b]
6	2798.0±63.0 [a]	2988.0±55.0 [a]	3032.3±12.0 [b]	3042.0±12.8 [b]
7	4885.0±106.1 [a]	4515.8±31.0 [a]	0.0±0.0 [b]	4605.5±46.7 [a]
8	3118.3±32.5 [a]	3100±42.3 [a]	3543.3±25.9 [b]	3446.3±44.5 [b]
9	2738.3±32.5 [a]	2857.3±49.7 [a]	3123.0±13.9 [b]	3071.5±49.1 [b]
10	4828.0±96.2 [a]	4804.0±89.1 [a]	0.0±0.0 [b]	0.0±0.0 [b]
11	4482.8±130.2 [a]	4392.5±23.7 [a]	0.0±0.0 [b]	0.0±0.0 [b]
12	2869.3±42.3 [a]	2926.5±7.9 [a]	3192.5±9.1 [b]	3224.0±37.1 [b]

As a result of statistical analysis it was found that the milkpowder, maltodextrin and polydexrose rates used in the ice cream samples had a significant effect (P<0.05) on the complete melting rates of the ice cream. Polydextrose used in the production of ice cream had a positive effect on complete melting. When polydextrose was used in the samples to which 2 % and 8 % milkpowder was

added and where comlete melting did not take place (samples 3 and 12), complete melting of the ice cream were observed. During the 3 months storage period the complete melting of the ice cream usually showed an increase after the second month. This increase was statistically significant ($P<0.05$).

More melting was observed at the first 15th minute in the samples 3, 6, 9 and 12 which especially contained polydextrose. The maltodextrin and polydextrose rates used in the production of ice cream had a significant effect ($P<0.05$) on the melting rate of the ice cream at the 15th minute. At the end of the statistical analysis it was found that using maltodextrin and polydextrose had a significant effect ($P<0.05$) on melting rate of the ice cream at the first 15 minutes while the milkpowder used at different rates had no significant effect ($P>0.05$). During the storage period the melting rates of ice cream had different values. These differences were found to be statistically significant ($P<0.05$). The melting rates of the ice cream at the 30th, 60th and 90th minutes were determined. According to the milkpowder rate used in the production of ice cream the melting rate first increased and then decreased. That is the highest melting rates were observed in the samples containing 4 % and 6 % milkpowder. As a result of the statistical analysis these differences were found to be significant ($P<0.05$). Using polydextrose and maltodextrin in the production of ice cream had a significant effect ($P<0.05$) on the melting rate of the ice cream. The storage period of the ice cream for 3 months had a significant effect ($P<0.05$) on the melting rate of of the ice cream.

According to this the viscosity values of the ice cream samples on the 1st day were found to be at the lowest 3.03 ± 0.06 $mm^2/sec.$ and at the highest 7.89 ± 0.27 $mm^2/sec.$ As a result of the statistical analysis no significant differences ($P>0.05$) were found between the storage time and the viscosity values of the ice cream (Table 6). While using different rates of milkpowder in the production of ice cream had a significant effect ($P<0.05$) on the viscosity values of the ice cream, the viscosity values of samples in which high rates of milkpowder amount used in the production of ice cream increased the resitance of the ice cream to flow also inreased that is the visvosity value has increased. Using maltodextrin and polydexrose had a significant effect ($P<0.05$) on the viscosity values of the ice cream.

Table 6. The viscosity values of the ice cream (mm^2 sec^{-1})

Ice cream	1. day	1.month	2.month	3.month
1	5.34±0.11 [a*]	5.33±0.11 [a]	5.36±0.05 [a]	5.12±0.55 [a]
2	5.04±0.34 [a]	5.02±0.17 [a]	4.92±0.17 [a]	4.87±0.11 [a]
3	3.03±0.06 [a]	3.09±0.03 [a]	3.06±0.02 [a]	3.16±0.03 [a]
4	5.18±0.13 [a]	4.84±1.09 [a]	5.27±0.09 [a]	5.22±0.08 [a]
5	4.45±0.41 [a]	4.42±0.23 [a]	4.44±0.24 [a]	4.38±0.19 [a]
6	3.45±0.09 [a]	3.31±0.12 [a]	3.38±0.08 [a]	3.38±0.08 [a]
7	6.10±0.07 [a]	5.98±0.16 [a]	5.99±0.06 [a]	5.96±0.07 [a]
8	5.48±0.06 [a]	5.41±0.11 [a]	5.46±0.04 [a]	5.44±0.04 [a]
9	6.15±0.12 [a]	6.11±0.09 [a]	6.12±0.02 [a]	6.14±0.04 [a]
10	7.89±0.27 [a]	8.08±0.10 [a]	8.14±0.03 [a]	8.18±0.03 [a]
11	7.08±0.10 [a]	7.22±0.06 [a]	7.18±0.05 [a]	7.13±0.02 [a]
12	7.03±0.09 [a]	7.11±0.01 [a]	7.09±0.05 [a]	7.10±0.02 [a]

Table 7 shows the sensory properties of the ice cream produced by using different rates of milkpowder, maltodextrin and polydextrose. While using different rates of milkpowder in the production of ice cream had no effect ($P>0.05$) on the colour and appearence, taste and smell; it had an effect on the structure and consistency ($P<0.05$).

Using polydextrose, maltodextrin and their combination did not effect the colour and appearance ($P>0.05$) but had an effect ($P<0.05$) on the structure and consistency, taste and smell. During the storage time a decrease was observed in the colour and apperance, structure and consistency, taste and smell scores of the ice cream and this decrease was found to be statistically significant ($p<0.05$).

Table 7. The sensory properties of the ice cream

Ice cream	Properties	1. day	1.month	2.month	3.month
	Colour and Appearence	5.00±0.00 [a*]	5.00±0.00 [a]	4.83±0.39 [b]	4.75±0.45 [b]
1	Structure and Consistency	3.13±0.86 [a]	3.21±1.20 [a]	2.46±0.58 [b]	2.93±1.00 [a]
	Taste and Smell	7.25±1.42 [a]	7.17±2.12 [a]	5.08±1.16 [b]	6.33±1.72 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.75±0.45 [ab]	4.42±0.51 [b]
2	Structure and Consistency	2.67±0.78 [a]	3.06±1.30 [b]	2.04±0.33 [a]	2.48±0.58 [a]
	Taste and Smell	6.33±1.44 [a]	7.17±1.99 [a]	4.58±1.08 [b]	5.92±1.51 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.79±0.40 [a]	4.25±0.45 [b]
3	Structure and Consistency	2.63±0.57 [a]	3.03±1.25 [b]	2.83±0.94 [ab]	2.20±0.51 [a]
	Taste and Smell	6.67±1.56 [a]	6.58±1.51 [a]	4.50±2.11 [b]	5.82±1.27 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.83±0.39 [a]	4.25±0.45 [b]
4	Structure and Consistency	3.33±0.91 [a]	3.66±1.16 [a]	2.67±0.89 [b]	2.92±0.51 [a]
	Taste and Smell	7.17±1.34 [a]	7.50±1.88 [a]	5.67±1.67 [b]	6.00±1.41 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.83±0.39 [a]	4.25±0.45 [b]
5	Structure and Consistency	3.29±0.92 [a]	3.50±1.51 [a]	2.25±0.75 [b]	2.83±0.39 [b]
	Taste and Smell	7.25±0.97 [a]	6.92±2.15 [a]	5.00±1.60 [b]	5.17±1.80 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.83±0.39 [a]	4.25±0.45 [b]
6	Structure and Consistency	3.13±0.98 [a]	3.50±1.30 [a]	2.27±0.90 [b]	2.76±0.69 [a]
	Taste and Smell	7.42±1.24 [a]	6.67±1.56 [a]	4.91±2.26 [b]	6.00±0.95 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.91±0.30 [a]	4.33±0.49 [b]
7	Structure and Consistency	3.90±1.03 [a]	3.93±1.11 [a]	3.45±0.85 [b]	3.80±0.87 [a]
	Taste and Smell	8.33±1.15 [a]	7.67±1.83 [a]	5.02±1.97 [b]	5.00±1.60 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.53±1.36 [ab]	4.17±0.39 [b]
8	Structure and Consistency	3.88±0.83 [a]	3.86±1.30 [a]	3.42±0.67 [b]	3.60±0.72 [a]
	Taste and Smell	7.50±1.73 [a]	6.92±1.31 [a]	5.00±1.35 [b]	5.00±1.35 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.75±0.45 [a]	4.17±0.39 [b]
9	Structure and Consistency	3.84±0.93 [a]	3.91±1.30 [a]	3.42±0.67 [ab]	3.65±0.72 [a]
	Taste and Smell	6.83±1.59 [a]	6.58±1.24 [a]	4.67±1.78 [b]	5.17±1.34 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.67±0.49 [a]	4.17±0.39 [b]
10	Structure and Consistency	3.25±0.75 [a]	3.38±0.88 [a]	2.95±0.96 [b]	3.00±0.65 [ab]
	Taste and Smell	6.50±1.51 [a]	6.50±1.73 [a]	5.42±2.43 [b]	5.92±1.24 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	5.00±0.00 [a]	4.25±0.45 [b]
11	Structure and Consistency	3.04±0.62 [a]	3.21±1.03 [a]	2.83±0.83 [b]	3.21±0.51 [a]
	Taste and Smell	6.42±1.78 [a]	5.33±1.92 [a]	5.08±1.88 [b]	5.92±1.51 [b]
	Colour and Appearence	5.00±0.00 [a]	5.00±0.00 [a]	4.92±0.49 [a]	4.25±0.45 [b]
12	Structure and Consistency	2.97±0.67 [a]	3.33±0.89 [b]	2.83±0.94 [a]	3.18±0.50 [ab]
	Taste and Smell	6.00±1.91 [a]	5.33±1.78 [a]	5.00±1.60 [b]	5.92±1.93 [b]

Discussion and Results

In the production of energy reduced ice cream using different rates of milkpowder had a significant effect on the pysical and sensory properties of the ice cream. The overrun did not only effect the density of the ice cream but also the eatability quality, resistance, yield and aliment value (ARBUCKLE, 1979). In the production of ice cream especially the high rates of milk non fat dry matter reduces the overrun (MARSHALL and ARBUCKLE, 1996). During the production of energy reduced ice cream as no fat and saccharose was sumpplemented the structures of the ice cream were weak. While increasing the milkpowder rate added to the ice cream to 6 % provided a decrease in this weakness, in the samples in which 8 % milkpowder was used the structure was damaged again because of the lactose crystalization. It was found out that using polydextrose in the production of ice cream had a more positive effect on the overrun than did the maltodextrin. As the overrun in the ice cream was high the structure was weaker and the head of the penetrometer could easily move throughout the samples in which polydextrose was used was found to be higher. The ice cream that dripped the earliest were samples 8 and 9 in which 6 % milkpowder were used and the ice cream that dripped the latest were the samples to which 8 % milkpowder was added, that is samples 10 and 11. In the samples in which only maltodextrin was used (samples 1, 4, 7 and 10) the first dripping time was longer than the other samples and in the samples in which only polydexrose was used (samples 3, 6, 9 and 12) the first dripping time was shortest when companed with the other samples.

In the production of energy reduced ice cream susbtituting fat and sugar with maltodextrin the ice cream produced melted late or did never melt. In these samples only whey separation took place and the remaining part turned into a cheese-like sutructure and remained unmelted. As a result of this findings it can be seen that low or high rates of milkpowder used in the production of ice cream has a negative effect on the complete melting time of the ice cream. The viscosity level was highest in the samples in which maltodextrin was used and lowest in the samples in which polydextrose was used. This result shows that the density increasing property of maltodextrin is higher than polydextrose. In contest to this, the samples in which polydextrose was used melting took palace earlier. Therefore, polydextrose has a more positive effect on the pyhsical properties of the ice cream than does moltodextrin. But, polydextrose containing samples had lower scores on the sensory analysis. In the production of energy reduced ice cream using sustances such as inulin, oligofructose together with the overrun substances (maltodextrin and polydextrose) were found to improve the structure and consistency and the sensory properties of the ice cream (GOFF, 1999, AYKAN, 2001). During the sensory evaluation it was determined by panelist that the samples containing polydextrose had a bad taste and the samples containing maltodextrin formed a more balanced taste. As a result, using equal amounts of these sustances in the production of ice cream will have positive result both on the physical and sensory properties of the ice cream.

During the storage period all the physical properties of the ice cream except the viscosity have changed. As the scores given to the sensory properties of the ice cream has decrease significantly during the storage period. It was found that the appropriate storage time for the ice cream should be 1 month.

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