INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 6, p. 19-24, 2014

RESEARCH PAPER OPEN ACCESS

Producing fructose syrup and its utilization in cocoa cream formulation

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Key words: Glucose syrup, fructose syrup, glucose isomerize enzyme, cocoa cream.

http://dx.doi.org/10.12692/ijb/4.6.19-24 Article published on March 20, 2014

Abstract

Using sweetening in ice-cream formulation in addition to make a sweet flavor in it, affects other factors such as freezing point, viscosity, airing power, formidability and tissue. The sugar used in ice cream is about 16% which is from Sucrose family. Noting that fructose is 1/5 times sweeter than sucrose , is the sweetest natural sugar and compared with synthetic sugar, has no side effects on consumer , using this material in food industry with various usages is common. In this study, using the enzyme glucose - isomer, the isomerization of glucose syrup at 60 and 80 ° C and pH 6.5, 7.5 and 8.5 were performed at 30 and 60 minutes. Fructose syrup produced from the isomerization process in four levels: 25, 50, 75 and 100 % of the sugar substitute and cocoa powder and cocoa in 2 levels, 2 and 4% cream formulation used in the manufacture of ice cream. Process isomerization glucose syrup in 12 treatments with 3 replicates and the ice cream cocoa in 8 treatments and 3 (cream cocoa with sugar sucrose 17%) with 3 replicates with a statistical factorial experiment in a completely randomized design were studied . Duncan's multiple range tests for comparison of means was used. The results showed that the optimum conditions for the enzymatic isomerization of glucose syrup into fructose syrup, temperature 60 ° C and pH = 7.5 and 60 min of treatment F6. Results showed an increased percentage of fructose, cocoa ice cream and cream formulations of cocoa powder, melting point and viscosity of air increases and decreases. In C1F2 treatments containing cocoa powder 4 percent fructose and 25 percent of general acceptance as a superior treatment was introduced.

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Introduction

With all the benefits that sucrose as a natural sweetener with superior performance characteristics are due to links with certain health problems such as high blood pressure , heart disease , tooth decay, obesity and increased levels of glucose , insulin for diabetics are particularly However, due to technological and economic harm and the sweetener is replaced by another . In fact, a mixture of glucose and fructose, fructose syrup is as sweet as sucrose solution of the same concentration (Foulkes, 1977). The food like ice cream, candy, soft drinks, sucrose is a better alternative. Isomerization of glucose to fructose by the enzyme glucose isomerize above syrup is produced. But it's a balance and to produce syrup contains 42 percent fructose and 58 percent glucose goes for application in the food is good , but for the production of beverages, syrup contains 55 percent fructose and production of jelly and jam, syrup contains 90 percent fructose required the ion-exchange chromatography columns to produce syrup is used (Bocarsly *et al.*, 2010). . Ice of a frozen mixture of milk ingredients, sweeteners, stabilizers, emulsifiers, and flavors are produced. One of the major drug formulations, cream , sweetener , which is aimed at producing sweet , voluminous effect , stabilized water (affecting shelf life) and control the freezing point of ice cream is added to the mix . Studies on the use of other resources such as sugar palm juice and honey ice cream has been formulated. In this study, the feasibility of using fructose syrup as a sweetener and its effect on sensory properties of ice cream, cocoa was studied.

The aim of this study is producing fructose syrup and its utilization in Cocoa cream formulation in Iran.

Materials and methods

Materials

The materials used in the production of fructose Syrup.

Glucose isomerize enzyme stabilized form of the bacterium (Streptomyces murinus) obtained from Novo Nordisk Inc.

Dextrose solution with pH = 3 and DE = 61.69 Dextrose from Iran.

Fructose and glucose powder and powder reagents from merck Germany.

Materials used in the manufacture of ice cream:

Sugar from Sugar Company of Qazvin

Dry Pak Dairy Company

Stabilizer from Behin Guard (Code 6924)

Cocoa powder Bensorope France

Vegetable oil from sunflower Laden

Low fat milk from dairy companies Pak.

Determine the optimum temperature for the enzyme activity of glucose isomerize

To determine the optimum temperature for the enzyme glucose isomerizes activity, temperature 60 and 80 ° C were studied. The first 50 ml of glucose solution Substra pH = 6.5, 7.5, 8.5 were prepared and the enzyme glucose isomerize was added to reach the desired temperature at 30 and 60 minutes each enzyme glucose solution Substra glucose isomerize enzyme glucose isomerize was isolated and was then stirred in 1 mL of 0.5 a normal amount of percloric acid was added to 9 ml of the enzyme is completely inactive and compact spectrometer at a wavelength of 560 nm, the amount of fructose to assist the measurement absorption intensity was measured .

The optimal pH for the enzyme activity of glucose isomerase

To determine the optimal pH for enzyme activity Tuesday buffer pH8.5 and 7.5 and 6.5 (potassium di hydrogen phosphate / disodium hydrogen phosphate) was prepared and 50 ml of glucose solution at pH were prepared Substra. After the addition of glucose isomerize enzyme solution and 60 minutes at 30 ° C were 60 and 80. The enzyme glucose isomerase solution Substra remaining acid into glucose and high fructose content inactivated normal 0.5 m at a wavelength of 560 nm spectrometer to measure the absorption intensity was measured.

Determine the effect of time product of fructose

To investigate the effect of the isomerization reaction of the enzyme solution was prepared Substra glucose, glucose isomerize enzyme Add Shadow at 60 and 80 ° C were maintained. At 30 and 60 minutes, the amount of fructose produced in any of the previous methods - carbasol - sulfuric acid was measured.

Cocoa Cream Formulation approaches in research

Blank cream preparation method

blank cream with 2 different formulations were prepared by the first formula consists of 17% sugar , dry milk , 2.5% , 0.5% stabilizer , cocoa powder 4% , oil 10 % and 66% skim milk) and the second formula of (17% the amount of sugar , dried milk , 2.5% , 0.5% stabilizer , cocoa powder 2% , oil 10 %, and skim milk 68 percent).

Method of producing fructose syrup ice cream

In the preparation of ice cream with syrup, fructose syrup, fructose replace sugar uptake at 4 levels (25 , 50 , 75 and 100 %) and also encouraging the body to consume cocoa powder 2 levels (2 and 4%) was added to the cream formulation . In order to prepare the ice cream and then weighing the dried material liquid (oil, milk, syrup, fructose) were added, and then 30 min at 72 ° C. At what stage during pasteurization and then mix in the ice water bath and ice cold in the fridge for 4 hours to complete the process during and after the process of making ice cream machine freezes during the construction phase. Semi-frozen samples were packed in plastic containers and lids freezing temperature -18 ° C until the tests were stored and transported. Tests carried out on ice cream production , including the cost , the percentage of air , melting point , sensory evaluation (extremely cold , stiffness, viscosity , degree of smoothness , fast- melting intensity, sweetness , general admission).

Data analysis

Sas.1 software was used for statistical analysis. Analysis of variance for a factorial experiment in a completely randomized design was used. The main effects of different levels of cocoa and fructose and Duncan's multiple range tests were used for comparison.

Results and discussion

The results of the comparison of the mean effect of temperature, pH, and time of fructose production are presented in Table 1.

Table 1. The comparison of average time effect, temperature, pH, and percentage of fructose.

factor	level	Percent of produced factor
Temperature	T =60c	77.696
	T = 80c	55.023
PH	pH=6.5	61.45
	pH=7.5	73.863
	pH=8.5	63.771
Time	t=30 min	68.087
	t=60 min	64.636

Table 2. The mean of viscosity, Airing percentage and Melting point in treatment.

treatment	viscosity	Airing percentage	Melting point
C1f1	866/40±4/613^{f}	33/16±0/288^{a}	19/05±0/086^{cd}
C1f2	581/66±4/163^{h}	33/00±0 ^{a}	21/66±0/577^{c}
C1f3	700/16±1/850^{g}	32/33±0/763 ^{a}	30/48±0/501^{ab}
C1f4	1984/33±5/131^{c}	32/16±1/040 ^{a}	32/00±0^{a}
C1f5	2359/67±13/796^{a}	31/50±1/732 ^{a}	29/71±5/686^{ab}
C2f1	357/63±2/478^{i}	33/16±0/288 ^{a}	15/03±0/577^{d}
C2f2	341/00±4/190^{j}	32/33±1/154 ^{a}	16/04±0/075^{d}
C2f3	1391/33±3/214^{e}	31/83±0/288 ^{a}	19/04±0/075^{cd}
C2f4	1674/00±11/532^{d}	31/00±1/322 ^{a}	21/04±0/069^{c}
C2f5	2344/00±11/532^{b}	30/83±1/443 ^{a}	26/33±5/773^{b}

Table 3. Mean of viscosity, Chill power, toughness, smoothness, melting pace, sweetness and Overall acceptance in treatment.

treatment	viscosity	Chill power	toughness	smoothness	Melting pace	sweetness	Overall acceptance
C1f1	6/23±1/729 [a]	6/85±1/424 [a]	6/61±1/359 [a]	5/14±2/174 [a]	5/52±2/112 [a]	7/14±2/414 [a]	7/95±1/395 [a]
C1f2	6/23±1/553 [a]	6/14±1/314 [a]	6/28±1/553 [ab]	4/90±1/946 [a]	5/85±1/681 [a]	6/80±1/833 [a]	7/47±1/435 [a]
C1f3	5/61±1/802 [a]	5/66±0/795 [a]	6/19±1/990 [ab]	4/61±1/321 [a]	5/61±1/359 [a]	5/80±1/806 [a]	5/80±1/833 [a]
C1f4	5/42±2/521 [a]	4/66±1/154 [a]	6/23±2/343 [ab]	4/19±1/327 [a]	5/33±2/129 [a]	5/80±2/249 [a]	4/47±1/833 [a]
C1f5	6/04±2/290 [a]	4/57±1/075 [a]	6/47±2/542 [a]	4/28±1/146 [a]	5/47±2/293 [a]	6/14±1/878 [a]	3/95±1/321 [a]
C2f1	6/71±2/171 [a]	5/09±2/364 [a]	6/95±1/687 [a]	4/33±1/906 [a]	5/04±2/224 [a]	6/42±1/719 [a]	7/33±1/591 [a]
C2f2	6/04±2/178 [a]	5/33±2/476 [a]	6/61±1/430 [a]	5/52±1/536 [a]	4/52±1/536 [a]	5/80±1/806 [a]	5/80±2/502 [a]
C2f3	4/95±1/596 [a]	4/57±1/866 [a]	5/09±1/091 [bc]	5/33±1/591 [a]	5/28±1/101 [a]	4/80±1/364 [a]	4/14±2/393 [a]
C2f4	4/85±2/080 [a]	4/47±1/939 [a]	4/85±1/768 [c]	5/47±2/135 [a]	5/52±1/569 [a]	4/66±2/129 [a]	3/61±1/986 [a]
C2f5	5/47±1/990 [a]	4/57±1/938 [a]	4/85±1/768 [c]	4/85±2/080 [a]	5/61±1/745 [a]	4/57±1/989 [a]	3/52±1/833 [a]

The result of comparison of the average parallel effect of fructose and cocoa on viscosity, percent of airing, melting point, is presented in table 2 and 3.

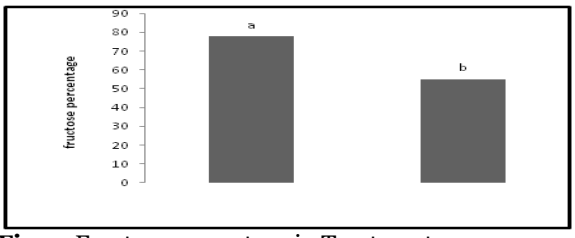

Fig. 1. Fructose percentage in Treatment.

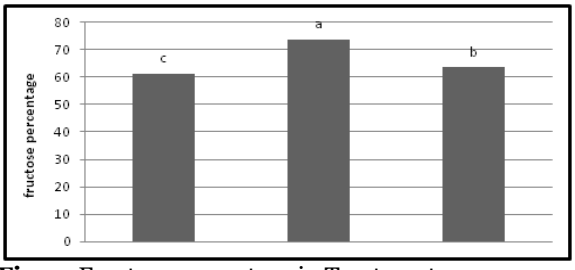

Fig. 2. Fructose percentage in Treatment.

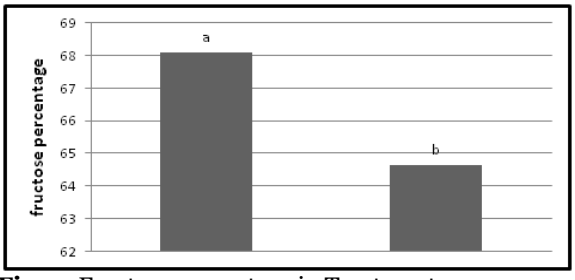

Fig. 3. Fructose percentage in Treatment.

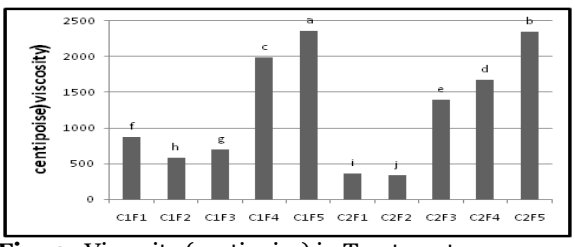

Fig. 4. Viscosity (centipoise) in Treatment.

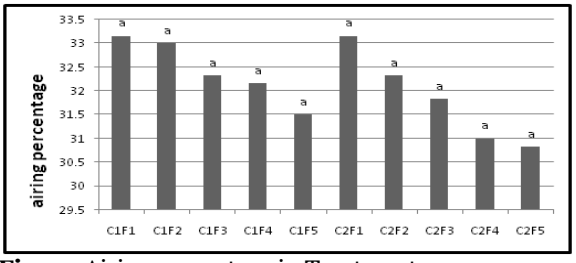

Fig. 5. Airing percentage in Treatment.

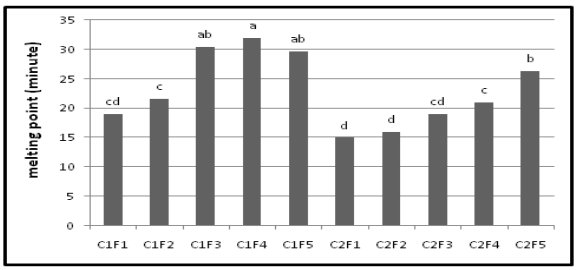

Fig. 6. Melting point (minute) in Treatment.

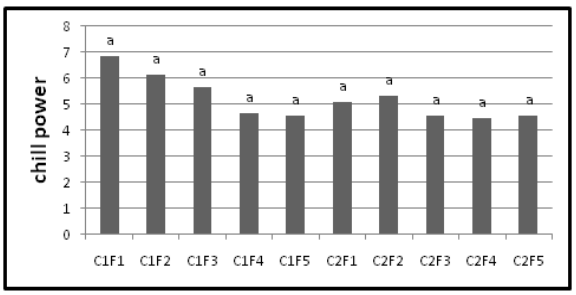

Fig. 7. Chill power in Treatment.

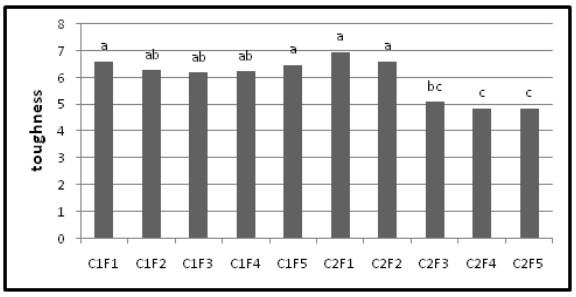

Fig. 8. Toughness in Treatment.

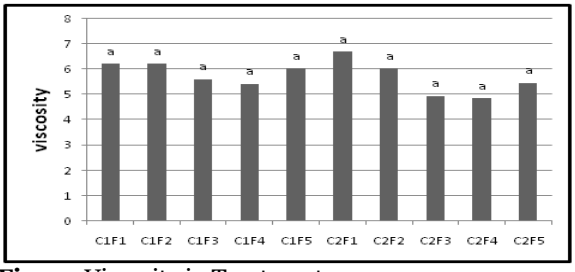

Fig. 9. Viscosity in Treatment.

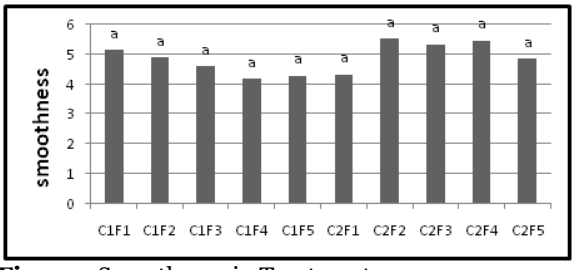

Fig. 10. Smoothness in Treatment.

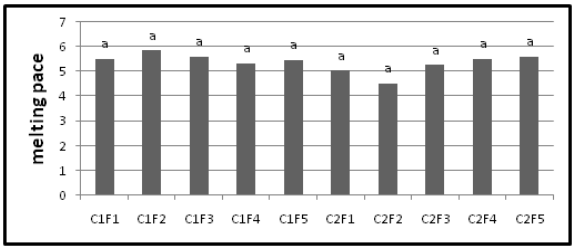

Fig. 11. Melting pace in Treatment

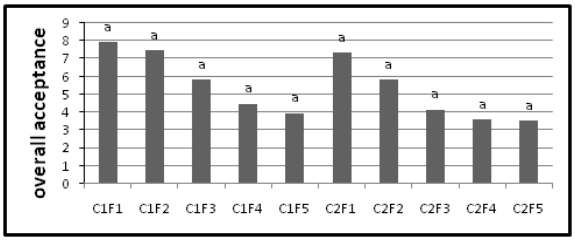

Fig. 12. overall acceptance in Treatment

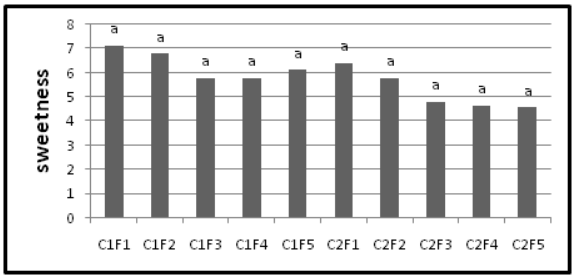

Fig. 13. Sweetness in Treatment.

Conclusion

Factors of temperature, pH, and glucose isomerize enzyme activators and inhibitors affect the activity. However, the results at 60 ° C and pH 7.5 are conditions of enzyme activity and stability. In this study, treatment f6 (temperature 60 ° C, 60 min, pH = 7.5) as the treatment of choice in the selection process for the enzymatic production of fructose syrup. The amount of fructose produced in this treatment was 97.2 percent.

Intensity sweeteners tend to absorb water, which is a function of molecular size and molecular weight of the polysaccharide is less inclined to absorb more water viscosity is increased . In this study, treatment c1f5 (100 percent fructose, cocoa powder, 4%), and had the highest viscosity among other treatments.

The results of the physical and emotional effects of fructose syrup were used in registration alone and in combination with the cocoa powder. In this study, the treatment of choice in terms of accepting a little ice cream production , treatment was C1f2 (4% and 25% fructose syrup , cocoa powder).

Acknowledgment

The authors are grateful staff of Pak co. for their helpful cooperative during this project.

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