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REPLACEMENT OF SUGAR SYRUP WITH HIGH-FRUCTOSE SYRUP  
IN IMITATION MAPLE SYRUP

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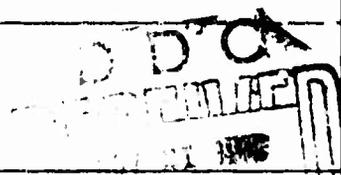
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Replacement of sugar syrup with high fructose syrup in imitation maple syrup (Type VIII of Federal Specification JJJ-S-351) was highly successful. High-fructose syrup is known commercially as ISOSWEET-100 or its equivalent ISOMEROSE. This formulation change can result in savings without sacrificing quality because of the high cost of sugar. This ingredient change can save the government approximately \$148,000/year. The imitation maple syrup products produced by Staley proved to be as stable as sucrose syrup blends for periods of up to 9 mos. at 38°C. Temperature cycling of the product (3 times from 38°C to 4°C to 38°C) did not result in any dextrose crystallization or turbidity in the product.		



## FOREWORD

The Military Services procured over 10 million pounds (4.5 million kilograms) of imitation maple syrup in FY 1974. By replacing either sugar or sugar syrup with high-fructose syrup, the ingredient cost could be reduced about 1.48¢/lb (3.26¢/kg) without affecting product characteristics. The overall savings that could be realized on a yearly basis would amount to approximately \$148,000.00. Since the commodities market is volatile, these figures are based on data available at the time of writing (10 October 1974). This study was performed under DOD Food Program Project Reference 728019.12.

The authors wish to acknowledge the assistance provided by Messrs. Donelon and Grigsby, A. E. Staley Company who provided the samples of high-fructose syrup and formulated products for the study.

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## INTRODUCTION

The Military Services procured over 10 million lbs. (4.5 million kg.) of imitation maple syrup in FY 1974 for use primarily for french toast and pancakes. The product is a high usage item and contains a sweetener ingredient, sucrose, which has escalated over 500% in price in 1 year's time. This report discusses the use of high-fructose syrup as a replacement for sucrose or sugar syrup. In this study a high-fructose syrup known commercially as ISOSWEET-100<sup>®</sup> (Staley) was tested. This sweetener is a wet-milled product produced from corn by a patented process of Takasaki, (U. S. Patent 3,616,221).

- Clinton Corn Processing Company holds the exclusive license in the United States and is sublicensing other producers such as Staley. Dextrose could also be used to partially replace sucrose but it was not investigated in these formulations because of a potential crystallization problem.

EXPERIMENTAL

Samples were prepared by A. E. Staley Manufacturing Company for U. S. Army Natick Laboratories following Federal Specification JJJ-S-351: paragraph 3.4.7.1, Class 1, Thin.

TABLE 1. Thin Syrup Formulation

<u>Code</u>	<u>Ingredients</u>	<u>Formula</u> (parts by wt - %)	<u>°Brix</u>
1 (Control)	Liquid sugar Corn syrup <sup>a</sup>	82.63 17.37	71.3
2	Liquid sugar <sup>b</sup> High-fructose syrup <sup>c</sup> Corn syrup <sup>a</sup>	42.18 40.10 17.72	71.2
3	High-fructose syrup Corn syrup <sup>a</sup>	72.57 27.43	71.2

<sup>a</sup>Staley NETO 7300 (42 D. E. high maltose).

<sup>b</sup>Liquid sugar was not totally replaced with high fructose syrup because dextrose might crystallize.

<sup>c</sup>ISOSWEET-100<sup>®</sup> (analysis-dry basis)  
 Dextrose 50%  
 Fructose 42%  
 Maltose 1.5%  
 Isomaltose 1.5%  
 Higher saccharides 5%

TABLE 2

Thick Syrup Formulation

<u>Code</u>	<u>Ingredients</u>	<u>Formula (parts by wt-%)</u>	<u>°Brix</u>
1 (Control)	Liquid sugar Corn syrup <sup>a</sup> Water	32.62 63.98 3.40	75
2	High-fructose syrup <sup>b</sup> Corn syrup <sup>a</sup> Water	29.83 64.79 5.38	74.5

<sup>a</sup>Staley NETO 1300 (42 E. E.)

<sup>b</sup>ISOSWEET -- 100 (R)

Liquid sugar used was 67.5% solids. All samples were prepared with 0.1% potassium sorbate as a preservative and pasteurized at 130-190°F (82.5° - 88°C). Color and flavor specifications were met by adding the following flavorings per 100 pounds (45.4 kg.) of syrup:

Salt	45.5 grams
Flavors	
Mapletone - Ottens	90.9 grams
Brown sugar flavor #2066 - Ottens	45.5 grams
Flavor compound, Maple Fritzsche - D & O	27.3 grams

Accelerated Storage

Samples of syrup were stored at 38°C in 1-pound (0.454 kg) jars and tested by a 30-member consumer panel at 0, 3, 6, and 9 months. Results are reported as mean acceptance scores (hedonic scale 1 - 9).

Temperature Cycling

Samples of the thick syrups were placed at 4°C for 2 - 3 days, observed, and then placed back in the 38°C room. This cycle was repeated three times.

## RESULTS AND DISCUSSION

Imitation maple syrup (either thin or thick) produced according to Federal Specification JJJ-S-351, Syrup, can be formulated with high-fructose syrup totally replacing either the sugar or sugar syrup with no problems from a technical standpoint. This conclusion is supported by the acceptance values given for thin and thick syrups, Tables 3 and 4. Products were tested at 0, 3, 6, and 9 months and received mean acceptance ratings from the consumer panel of not less than "like slightly" at any of the withdrawal periods. There were no significant preferences for the different formulations of any of the blends of thin syrups. At the 6-month withdrawal period the thick syrup sample containing high-fructose syrup was preferred over its counterpart made with sugar syrup. This difference in preference did not repeat itself at the 9-month withdrawal period and is considered an anomaly.

When the finished product was cycled from 38°C to 4°C for 3 successive times, the product showed no dextrose crystallization or change in color (opacity).

The current price of sugar is about \$0.42/lb. (\$0.93/kg.) (8 October 1974) whereas ISOSWEET-100 sells for \$0.26/lb. (\$0.57/kg.). This cost differential has put a strain on the supply of high-fructose syrup which is now on allocation. Nevertheless, the future of this product appears bright since at least three new producers are scheduled to go on stream in the near future.

Relative sweetness of the common sweeteners is shown in the Figure 1. It can be visualized that a 15% high-fructose syrup is equivalent in sweetness to 14% medium invert syrup, to a 15% bottlers' sucrose, and to a 19.2% dextrose.

TABLE 3

Acceptance Ratings<sup>a</sup> (N=30) by Consumer Panel  
of Thin Imitation Maple Syrup Stored At 38°C

<u>Sample Code</u>	<u>Months</u>			
	<u>0</u>	<u>3</u>	<u>6</u>	<u>9</u>
1	6.8	6.8	6.9	6.9
2	6.9	6.8	6.6	6.9
3	6.9	7.1	6.8	6.6
L.S.D.	N.S.	N.S.	N.S.	N.S.

a=mean ratings - hedonic scale 1-9 (Peryam and Pilgrim, 1957).

N=number of panelists.

L.S.D. = Least significant difference.

N.S. = not significant

TABLE 4

Acceptance Ratings<sup>a</sup> (N=30) by Consumer Panel at Timed Intervals  
of Thick Imitation Maple Syrup Stored at 38°C

<u>Sample Code</u>	<u>Months</u>			
	<u>0</u>	<u>3</u>	<u>6</u>	<u>9</u>
1	6.7	6.5	6.0*	6.3
2	7.3	7.0	6.9	6.5
L.S.D.	N.S.	N.S.	0.8	N.S.

\* = significant at 5% level.

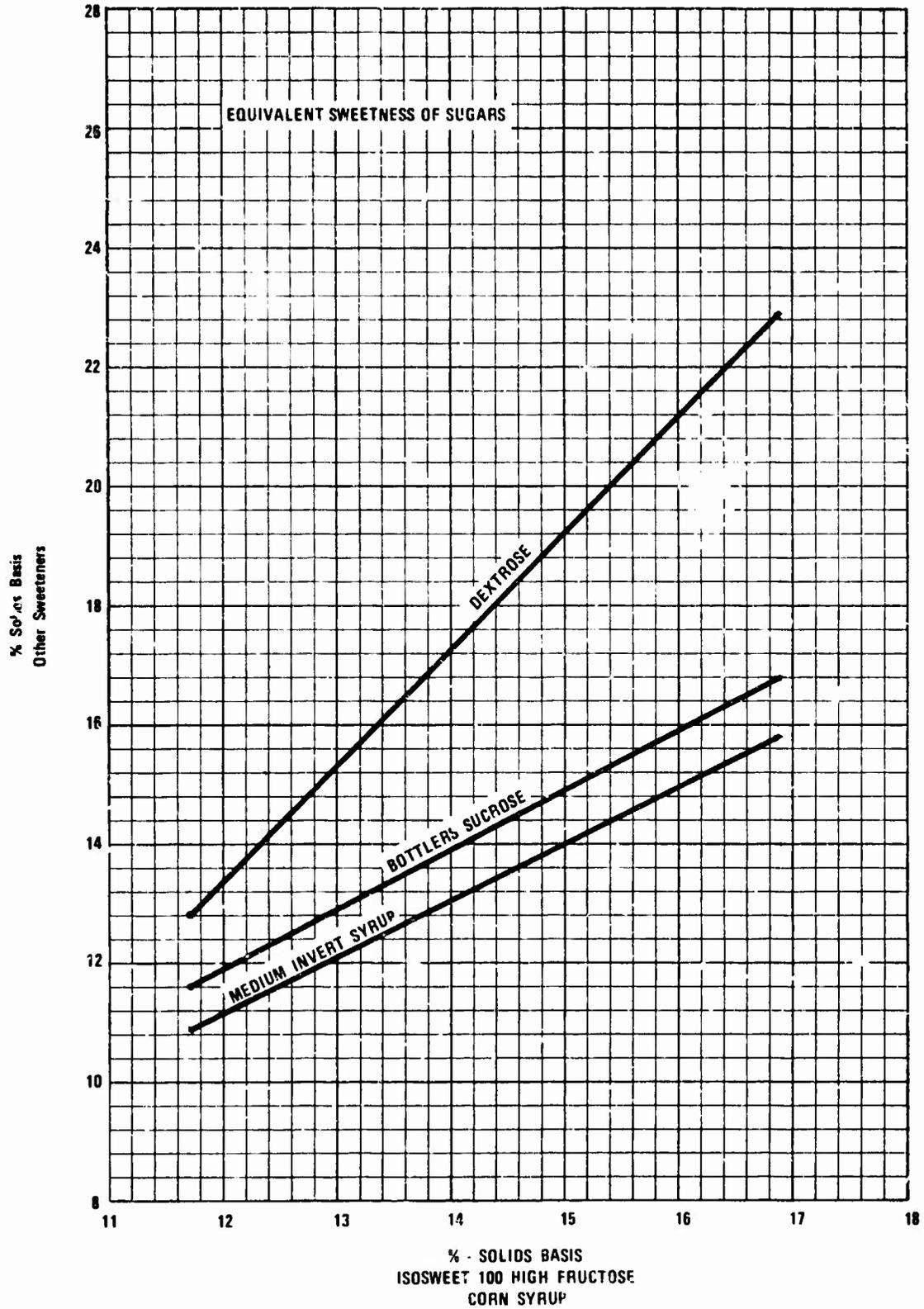
N.S. = not significant.

a = mean ratings - hedonic scale 1-9.

## CONCLUSIONS

High-fructose syrup has been demonstrated to be a suitable substitute for sugar or sugar syrup in imitation maple syrup. The use of the product results in considerable dollar savings under current market conditions. Accordingly, Federal Specification entitled Syrup, was amended to reflect these results. The savings to the government are considerable and will accrue in years to come if sugar is scarce when corn is abundant and the price differential is maintained.

FIGURE - 1



## REFERENCES

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