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Mr. Cosler presents some challenging ideas in this personal study of the shelf-life of candies prepared for the quartermaster corps. The conclusions are mainly his own, based on the experience of several years in dealing with specification candy for the armed forces, and on many years of candy production management in industry before that. Executives can hardly afford not to examine the data in this article and to give the ideas presented serious thought, as these ideas provide one of the few avenues of substantial cost reduction and product improvement open to the manufacturer today.

Is a "made-to-order" shelf-life possible for candy?

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When the confections were assembled for the storage studies in military rations x, there were a few more of each type received than were needed for the study. It was decided that it would be of interest to store these at room temperature in loose covered boxes. This would correspond to conditions as would exist in commercial practice and show the effect of antioxidants and humectants in confections under these conditions. It would also provide a comparison as to shelf life between normal storage and storage in the moisture proof, vapor proof containers of the rations.

The boxes containing the bars and discs were stored in the storage room at the Food and Container Institute. This room was not air conditioned and temperatures varied from a low of 60° to 65°F at night and over weekends in the winter to a high of whatever temperatures reached in the summer. The storage period was from June 1951 to June 1953. The summer of 1952 had 39 days of over 90°F. No attempt was made to control humidity and this followed the outside humidity. The candies were examined at six month intervals by two people familiar with candy requirements. This report

covers the one year and two year examinations as differences were most pronounced at these periods and a full season of climatic change was covered. The candies were made on the formulas in the Military Specifications 10928 (QMC) dated Feb. 12 1951, since revised. When coated, the special "chocolate type" coating as specified therein, was used.

The Specification formulas differ from commercial formulas in that they generally specify non fat milk, coconut or high lauric acid fats, an antioxidant mixture (formulation given) and a humectant, usually designated as sorbitol.

Coated Fudge Bars

The Specification formula for fudge calls for 10 per cent sorbitol solids and .01 per cent antioxidant mix-

Unfortunately no results are available for peanut or peanut butter bars as they became infested and were destroyed after six months. The study of Confections in Military Rations under Varying Temperatures. The Manufacturing Confectioner. Vol. XXXIII No. 10 October 1953. H. B. Cosler, J. G. Woodroof, and Barbara Grant.

ture. There were no fudge bars without sorbitol and antioxidant mixture available for comparison.

A. Fudge Bars made on Specification formula.

1. Year. Consistency good, very soft. Flavor good.
- 2 Years. Consistency good. Slightly harder than at 1 year. Flavor good.

B. Fudge Bars made on Specification formula with 4 per cent additional sorbitol (14 per cent total).

- 1 Year. Consistency good, very soft. Flavor good.
- 2 Years. Consistency good. Softer than A at 2 years. Flavor good.

The coating on both type bars was in very good condition. The addition of 4 per cent sorbitol solids (14% total) did not seem to be of benefit the first year but was of some benefit after 2 years. Fudge bars in open storage were in better condition than those in the rations stored at 70°. This is probably due to the ration fudge bars absorbing flavors from the other components such as tobacco from the cigarettes in the rations.

Coated Coconut Bars

The Specification formula calls for .01 per cent antioxidant mixture but no added sorbitol. The bars tested were the fondant cream type center.

A. Specification Formula.

- 1 Year. Soft. Edible, Flavor good.
- 2 Years. Dry and graining. Flavor soapy.

A. Specification formula with 8 percent sorbitol solids.

- 1 Year. Soft. Edible. Flavor good.
- 2 Years. Graining. Flavor soapy.

The coating on both bars was in very good condition. Both bars were still edible after 1 year but were not considered edible after 2 years. The antioxidant mixture may have helped to retard oxidation. Sorbitol did not seem to be of benefit in these bars. Here again the bars in open storage remained in better condition for a longer time than those in the rations at 70° F.

Caramel Nougat Bars

The Specification formula for caramel nougat bars and discs specifies antioxidant mixture but no added sorbitol.

A. Specification formula. Coconut oil and no sorbitol.

- 1 Year. Slight graining of caramel. Nougat dry and graining. Flavor good.
- 2 Years. Further graining of caramel. Nougat very dry. Flavor fair.

B. Specification formula. Coconut oil with 5 per cent sorbitol solids in both caramel and nougat phases.

- 1 Year. Soft. No graining. Good consistency. Flavor good.
- 2 Years. Soft. No graining. Good consistency. Flavor fair.

C. Specification formula. Coconut oil replaced with hydrogenated cottonseed oil. 5 per cent Sorbitol in both caramel and nougat phases.

- 1 Year. Soft. No graining. Good consistency. Flavor good.

2 Years. Soft. No graining. Good consistency. Flavor fair.

D. Specification formula. Coconut oil replaced with hydrogenated soy bean oil. 5 per cent sorbitol in both caramel and nougat phases.

- 1 Year. Soft. No graining. Good consistency. Flavor good.
- 2 Years. Soft. No Graining. Good consistency. Flavor good.

Caramel nougat discs made on the same formulations followed the same pattern.

The coatings in all cases were in good condition. Hydrogenated cottonseed or soy bean oil can replace the coconut oil without affecting the shelf life. The addition of sorbitol is of definite benefit in extending the shelf life. In this case there was little difference in the bars and discs in open storage and those in the rations at 70°F.

Starch Jellies with Fruit

A. Specification formula. (25 per cent dried raisins and figs).

1. Year. Soft. Very good. Good flavor.
- 2 Years. Fairly soft. Good flavor.

B. Specification formula with 5 per cent sorbitol solids.

- 1 Year. Soft. Very good. Good flavor.
- 2 Years. Soft. Good flavor.

This candy remains in good condition over a long period of time. The difference in shelf life is not enough to warrant the addition of sorbitol. There was little difference in flavor acceptability between the bars and discs in open storage and those in rations at 70°F. Those in the rations did "sweat" and as the moisture could not evaporate as in the case of open storage, it dissolved part of the sanding sugar.

Starch Jellies without Fruit

A. Specification formula. (Corresponds to commercial formulas.)

- 1 Year. Hard. Almost completely grained. Inedible.
- 2 Years. Hard. Completely grained. Inedible.

B. Specification formula with 3 per cent sorbitol. (Lime flavor).

- 1 Year. Slight grain formation around outer edge. Flavor good.
- 2 Years. Firm. About one third grained. Center soft and chewy. Flavor good.

C. Specification formula with 5 per cent sorbitol. (Orange flavor).

- 1 Year. Good consistency. No graining. Slightly chewy. Flavor good.
- 2 Years. No graining. Chewy. Orange flavor deteriorating.

Here again the starch jellies in open storage rather closely followed the pattern of the starch jellies in the rations at the 70°F storage except that some 'sweating' occurred in the ration storage with the 5 per cent sorbitol. Starch jellies without fruit show definite increases in shelf life when sorbitol is added.

Chewy Caramels

Specification formula specifies antioxidant but no humectant.

A. Specification formula.

1 Year. Grained about 1/16 inch around edge. Flavor good.

2 Years. Almost completely grained. Flavor good.

B. Specification formula with 5 per cent sorbitol solids.

1 Year. Slight indication of grain around edge. Chewy. Flavor good.

2 Years. Grained about 1/16 inch around edge. Chewy. Flavor good.

C. Specification formula with 8 per cent sorbitol solids.

1 Year. No indication of grain. Chewy. Flavor good.

2 Years. Slight indication of grain around edge. Chewy. Flavor good.

The flavor remained good without evidence of rancidity. The addition of 5 per cent sorbitol was of material benefit and at the 8 per cent level the caramels remained ungrained for almost two years. These results are somewhat similar to those of the rations at the 70° storage.

Grained Caramels

Specification formula specifies antioxidant but no humectant.

A. Specification formula.

1 Year. Rather firm. Edible. Flavor good.

2 Years. Very hard. Cannot bite through. Flavor good.

B. Specification formula with 5 per cent sorbitol solids.

1 Year. Soft. Good condition. Flavor good.

2 Years. Soft. Good texture. Flavor good.

C. Specification formula with 8 per cent sorbitol solids.

1 Year. Softer than B at 1 year. Flavor good.

2 Years. Softer than B at 2 years. Flavor good.

The flavor in all cases has remained good. The addition of sorbitol has extended the shelf life. The results are similar to the caramels in the rations stored at 70°F.

Chewy Chocolate Rolls

Specification Formula specifies antioxidant but no humectant.

A. Specification formula.

1 Year. Fairly soft. Flavor good.

2 Years. Firm. Almost impossible to bite through. Flavor good.

B. Specification formula with 2 percent sorbitol.

1 Year. Softer than A at 1 year. Flavor good.

2 Years. About like A at one year.

C. Specification formula with 5 per cent sorbitol.

1 Year. As soft as when first made. Flavor good.

2 Years. Very little change from 1 year. Flavor good.

The flavor has remained good in all cases with no evidence of rancidity. This was a special experiment and was not included in the ration storage studies. The ad-

dition of sorbitol materially extends the shelf life, particularly at the 5 per cent level.

Candy Corn

Specification formula does not specify antioxidant or humectant.

A. Specification formula.

1 Year. Spotty, grainy appearance. Very hard. Unacceptable.

2 Years. No test.

B. Specification formula with 3 per cent sorbitol.

1 Year. Good appearance. Slightly chewy. Flavor good.

2 Years. Appearance slightly grainy. Chewy. Flavor good.

C. Specification formula with 5 per cent sorbitol.

1 Year. Appearance good. Consistency good. Flavor good.

2 Years. Appearance good. Slightly chewy. Flavor good.

In the case of candy corn the addition of sorbitol even at low levels materially increased the shelf life. The results are similar to those of the rations stored at 70°F. The appearance of the candy corn in open storage after 1 and 2 years was better than that stored in the rations at 70°.

The coatings made on the specification formulas were in very good condition in all cases at the end of the two year storage period.

In most cases the candies stored in the open storage were in better condition than those in the tight ration containers stored at 70°F. This is particularly true of flavor. Flavors of candies in open storage changed very little compared to those in the rations. Flavor changes in the ration candies were due to a great extent to the absorption of flavors of other ration components. Moisture changes of the candy in the open storage had a different physical effect on the candy than when they occurred in the tight ration containers. In the ration containers "sweating" occurred in some instances and dissolved some of the surface sugar. If this occurred in the open storage it was not evident at any examination. This is probably due to the fact that the moisture could evaporate. The addition of antioxidant seems to be of doubtful benefit. It is probably unnecessary when coconut fats or hydrogenated soy, cottonseed, or peanut fats are used. The addition of sorbitol materially extended the shelf life in all cases except the coconut candies and the starch jellies with fruit. Sorbitol proved in another way to be a very satisfactory humectant in that the candy to which it was added changed very little when drastic changes in humidity and temperature occurred.

As stated at the beginning of this article, the comparisons are for 1 and 2 years storage because the differences are more pronounced. It is realized that no candy manufacturer would build his product for a 2 year shelf life. Many however, for reasons of security and reputation would like to build six to nine months and preferably a years shelf life into their products even though they expect them to be consumed within 1 to 3 months after manufacture. From these results it would appear that a manufacturer could determine the maximum shelf

life desired for his product and then by the use of the proper raw materials, antioxidants, and humectants, could produce a confection to meet the shelf life conditions with little or no dependence on special packaging materials for protection.

For example, a chewy, wrapped caramel could be formulated with non fat milk and coconut or hydrogenated vegetable fats. Fats with added milk culture could be used or imitation butter flavor added to enrich the flavor. Or if whole milk or butterfat is used, it has been proven by Martin and Robinson of the Southern Regional Laboratories, that the addition of certain antioxidants extends the shelf life by several months. In either case the danger of oxidative rancidity would be eliminated for several months. To prevent the caramel from drying out and graining, at least 5 per cent of sorbitol should be added to provide for six to eight months protection, more for longer protection. Caramels made with these ingredients should be little changed after several months under ordinary storage conditions and without the use of special protective box wrappers.

Most non chocolate coated candy could be formulated for a similar shelf life as could centers for chocolate coated candies.

Even the coating itself can be tailored to meet climatic conditions. Since the development of a heat and bloom resistant "chocolate type" coating by the Food and Container Institute of the Quartermaster, industry has shown much interest in it. A bar manufacturer coated part of a lot of specification formulated bar centers with the light milk type specification coating and the remainder

with the milk chocolate coating used on his popular and well established bars. Taste tested at the Food and Container Institute by a rather large (40) panel, there was no significant difference between the two in acceptance. The one with the specification coating rated 7.0 and the one with the milk chocolate 7.3 on the nine point Hedonic scale. It would not be unreasonable to predict that within the next few years, the "chocolate type" coatings in the candy field will have progressed to a position similar to that occupied today by the margarines and the frozen desserts in their field.

Based on the technological advances to date and those anticipated in the future, the answer to the title of this article is "Yes".

The End.

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