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LITERATURE CITED

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GEL-COATED READY-TO-SERVE GRAPEFRUIT HALVES

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ABSTRACT

Center cavity and cut surface of fresh grapefruit halves were filled and sealed with a citrus gel to prevent shrinkage and leakage, thus extending the life of ready-to-serve grapefruit halves for restaurant and supermarket trades. The prepared product is wrapped with polypropylene shrink film and stored at 40°F. After three weeks storage at 40°F., the gel-coated halves appeared free of fungal growth with only slight shrinkage, whereas, the control samples without gel coating had mold growth on the surface of the cut fruit after 19 days and severe shrinkage and leakage of the grapefruit sections occurred within one week. The gel was made attractive with certified food colorings and each grapefruit half was garnished with a disc of colored, candied citrus peel in its center. Flavor of the gel was enhanced with the addition of sugar, honey, or non-caloric sweeteners and grapefruit oil essence.

INTRODUCTION

Ready-to-eat grapefruit halves, a new 'convenience' food sealed with a grapefruit gel that is over 98% citrus, resulted this past year from the combined efforts of three organizations to prepare and place before restaurant operators, home economists, and other interested groups for their evaluation.

In 1966-67, seven tests were carried out to determine if grapefruit halves could be prepared for eating and marketed under refrigeration. These exploratory studies indicated that: a) complete loosening of each segment was not practical; b) removal of seeds could be done with a simple instrument but juice accumulated in the resultant cavity; c) Saran film was unsuitable for wrapping; d) shrinkfilm wrapping made an acceptable package for three days, but after seven days at 40°F. perceptible drying of the albedo caused an old appearance; and e) of four types of shrinkfilm tested, the most suitable was Reynolds GSP polypropylene film. Very short term marketing might be practiced, not more than 5 days from preparation to consumption.

During the past two years, we have formulated several types of gels. We speculated that one of these formulations could be used for pre-coating the surface of freshly cut grapefruit halves to prevent shrinkage and leakage and that grapefruit essence might enhance the grapefruit odor and taste of the product. The grapefruit water and oil essences might also act as a deterrent to fungal growth on the cut grapefruit surface and peel.

The purpose of this paper is to present in-

formation on gel formulation and procedures for the practical production of decorative, gel-coated, ready-to-serve grapefruit halves.

PROCEDURE

Seeded and seedless grapefruit (white and pink) were washed, waxed, sized, cut in half, bottom of fruit trimmed to set evenly in trays, cored with a drill press using a 1- to 1.5-inch bit, and extraneous material removed from the center of the grapefruit. A ¼-inch deep cut was made around the grapefruit half between the albedo and the sections to facilitate insertion of a grapefruit spoon for easy removal of the fruit sections. Grapefruit halves were allowed to drain 5 minutes on a stainless steel screen after which the center cavity was filled and the cut surface of the grapefruit sealed with a citrus gel. This operation utilized a jacketed Simplex, Model A, filler which maintained the gel solution between 165°-170°F. Small discs of colored, candied grapefruit peel were placed onto the center of each half for decorative purpose just before gelation. The gel was allowed to set for 15 minutes and the grapefruit halves placed onto cardboard or plastic packets, which held two or eight halves respectively, and wrapped in polypropylene shrinkfilm. The wrapped products were packaged into cartons and placed in 40°F. storage.

Gel ingredients.—The following two types of gel mixes met the requirement to form a quick-set gel for the center cavity and for the surface coating of grapefruit halves.

GEL MIX

	No. 1	No. 2
Low methoxyl pectin (LMP)	80.0%	36.95%
Locust bean gum (LGB)	20.0	18.51
Gelcarin FC	---	22.27
Gelcarin DG	---	22.27
	100.0	100.0

Mix No. 2 is prepared by Marine Colloids, Inc., Springfield, New Jersey and is called Sea Gel PCL-2. The Gelcarins are carrageenans that are extracted from seaweed. Low methoxyl pectin, an extract of citrus peel, requires the presence of calcium ion for proper gelation. Grapefruit juice contains natural calcium salts, but an addition of 14 mg Ca per g of pectin is advis-

able in the form of a soluble calcium salt. If a non-caloric sweetener is used in place of sugar, such as calcium cyclamate, then sufficient calcium ions would be available.

Gel formulations.—Gel preparation for protecting freshly-cut-grapefruit halves requires that the gel set quickly and that the gel in the center cavity does not contract, resulting in a sunken center. For a continuous processing line, the surface coating should gel in 15 minutes or the shrinkfilm wrapping which comes in contact with the surface of the fruit will disturb the gel coating. Precooling the grapefruit to 40°F. prior to cutting and coring is desirable to hasten gelation.

Two formulations are given below and the gel mixes are interchangeable.

GEL FORMULAS

	No. 1	No. 2
Gel mix	1.50% (LMP and LGB)	1.30% (Sea Gel PCL-2)
Grapefruit juice	98.18	78.51
Calcium chloride (anhyd.)	---	0.02
Calcium cyclamate	0.15	---
Sugar	---	10.00
Honey	---	10.00
Oil essence emulsion	0.17	0.17
	100.00	100.00

The gel mix is dispersed in grapefruit juice at room temperature in a jacketed kettle with vigorous agitation and then heated to 180°F. The calcium salt is heated with a small quantity of grapefruit juice just below the boiling point and added slowly to the hot dispersed mix in the kettle. Sugar and/or honey is added which will lower the temperature to between 165°-170°F. If a non-caloric sweetener is used, let the temperature of the mixture in the kettle drop to 170°F. At this point grapefruit oil essence emulsion is added and the mixture transferred to the jacketed Simplex, Model A, filler. The temperature in the filler is maintained by circulating water at 170°F. through the jacket. Fill the hot gel solution into the center cavity and spread over the cut surface of the grapefruit.

When high Brix grapefruit concentrate (60°) is used, which is more convenient and uniform than extracted juice, the gel mix is dis-

persed in the proper quantity of water. Then the same procedure given above is followed, except the concentrate and sugar are blended together and added immediately after the addition of the hot calcium salt solution.

The oil essence emulsion contains 12% by weight of equal amounts of grapefruit oil essence and cold pressed peel oil. Suggested formula is as follows:

OIL ESSENCE EMULSION FORMULA

Uncut pectin (200 grade)	2g
Locust bean gum	1
Sucrose	10
Water	75
Grapefruit oil essence	6
Grapefruit cold pressed oil	6
	100

Butylated hydroxy toluene is used as an anti-oxidant, 500 ppm being added to the grapefruit oil.

Color and Flavor Enhancement.—The addition of certified food coloring, such as a pale yellow, green or pink, to the gel increases the attractiveness of the ready-to-serve grapefruit halves, especially if the gel in the center cavity is a deeper yellow, green or pink than the surface coating. Garnishing the grapefruit halves with a piece of red or green maraschino cherry or a disc of red or green candied grapefruit peel in the center of the surface, just before the gel hardens, also adds to its attractiveness.

Spraying the surface and bottom of the fruit with a blend of water essence and oil essence (30-1) not only enhances the grapefruit odor, but deters decay of the peel.

Suggested edible life of gel-coated ready-to-serve grapefruit halves.—Normally, ready-to-eat grapefruit halves are freshly prepared each day for the restaurant and cafeteria trade and may keep 48 hours provided they are kept chilled. After one week, they are shrunken and may have an old taste. Fungal growth has been observed on the bottom of the grapefruit after two weeks storage at 40°F, particularly when the peel was trimmed to make the halves set evenly. Grapefruit halves coated with a gel showed neither shrinkage nor leakage at the end of two weeks storage at 40°F and those halves sprayed with

a blend of water and oil essences showed no decay. Furthermore, the grapefruit sections were still succulent and had a fresh taste. After three weeks storage at 40°F, the gel coating and the candied peel in the center of the surface had softened causing syneresis. This was probably due to the hydrolytic action of the pectolytic enzyme depolymerase which is present in grapefruit.

These observations indicated that wrapped, gel-coated, ready-to-serve grapefruit halves have a potential marketing life of two weeks if kept at 40°F.

Market testing.—Over 1,000 grapefruit halves were prepared with gel coating and sent to restaurateurs, home economists, and other food experts for their evaluation. To such food authorities, the main attraction of this product was lack of shrinkage of the grapefruit sections and the fruit could be inverted without juice spillage.

Further comments from the Food Science Industry toward this new product were that it had "great taste (like fresh cut grapefruit), excellent appearance, good idea, and labor saving." Hospital representatives liked the idea because it would help cut labor costs in their kitchens and they also stated that the idea of sugar or cyclamate in the gel coating was especially good. A majority of these food experts tasting the product showed a preference for the cyclamate sweetener in the gel coating over either sugar or honey as a sweetener (F. J. Mulkeen, State of Florida, Department of Citrus, personal communication).

A pilot plant scale operation appears to be justified and will certainly be necessary before details of production, packaging, and commercial distribution can be perfected.

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