THESIS

on

HONEY AND ITS USE IN COOKERY

Submitted to the

OREGON STATE AGRICULTURAL COLLEGE

In partial fulfillment of
the requirements for the
Degree of

MASTER OF SCIENCE

by

Helen Lee Kelleway

June, 1930
APPROVED:

Redacted for privacy

Professor of Department of Foods and Nutrition.

Redacted for privacy

Chairman of Committee on Graduate Study.
ACKNOWLEDGMENT

The author desires to express appreciation for the help of those who have assisted in the supervision and preparation of this Thesis. She especially desires to express appreciation to Miss Agnes Kolshorn, Assistant Professor in the Department of Foods and Nutrition, and Mr. Scullen, Associate Professor of the Entomology Department.
<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Introduction</td>
</tr>
<tr>
<td>II. Historical</td>
</tr>
<tr>
<td>A. Kinds of Honey</td>
</tr>
<tr>
<td>1. Classification</td>
</tr>
<tr>
<td>2. Difference in Color in Honey</td>
</tr>
<tr>
<td>3. Difference in Flavor of Honey</td>
</tr>
<tr>
<td>B. Geographical Distribution and Characteristics of Honey</td>
</tr>
<tr>
<td>1. Eastern Honey</td>
</tr>
<tr>
<td>2. Western Honey</td>
</tr>
<tr>
<td>3. Oregon Honey</td>
</tr>
<tr>
<td>C. Production and Consumption</td>
</tr>
<tr>
<td>1. Production in the U. S.</td>
</tr>
<tr>
<td>2. Imports and Exports</td>
</tr>
<tr>
<td>3. Production in Oregon, Washington, and California</td>
</tr>
<tr>
<td>4. Marketing and Containers</td>
</tr>
<tr>
<td>5. Forms of Marketing</td>
</tr>
<tr>
<td>D. Composition of Honey</td>
</tr>
<tr>
<td>1. Change in Evaporation of Honey</td>
</tr>
<tr>
<td>2. Chemical Analysis</td>
</tr>
<tr>
<td>3. Average Composition</td>
</tr>
<tr>
<td>4. Sugars found in Honey</td>
</tr>
<tr>
<td>5. Minerals found in Honey</td>
</tr>
<tr>
<td>6. Vitamins found in Honey</td>
</tr>
<tr>
<td>7. Fuel Value of Honey in Comparison with Sugar,</td>
</tr>
</tbody>
</table>
sirup, and molasses

E. Adulteration of Honey
F. Granulation of Honey

III. Experimental

A. Honey as a Food
   1. Samples of Honey used.
   2. Price of Honey in Corvallis compared with Molasses, Sugar and Sirup.
   3. Table of Abbreviations
   4. Table of Weights
   5. General Score Card
   6. Uses of Honey in Various Desserts
      a. Cornstarch Pudding
      b. Cocoa Cornstarch Pudding
      c. Lemon Pudding
      d. Apricot Whip
      e. Meringue
   7. Use of Honey in Batters and Doughs
      a. Cake (Print of Cake)
      b. Gingerbread
      c. Plain Cookies
      d. Ice-box Cookies
      e. Score Card
   8. Use of Honey in Beverages
      a. Coffee
      b. Tea
      c. Cocoa
d. Lemonade

9. Use of Honey in Fruit Salad Dressing

10 Use of Honey in Fruits
   a. Baked Apples
   b. Grapefruit

11 Use of Honey in Vegetables
   a. Sweet Potatoes

12 Use of Honey in Candy
   a. Fudge
   b. Popcorn Balls

13 Use of Honey in Jelly
   a. Grape Jelly

IV. Conclusion

V. Bibliography
HONEY AND ITS USE IN COOKERY

I INTRODUCTION

The object of this Thesis is to give a general survey of collected data relevant to honey production in the United States and to determine some of the possible uses of honey in food preparation. Consideration was given to the study of the importance of the industry in the United States with investigation as to the composition and properties which characterize honey as a valuable food.

II HISTORICAL

The use of honey as a food goes back as far as we have any record. The first record of bees was kept by Aristotle in the fourth century. He gathered together all he could learn of bees, and as men studied these scripts the knowledge he collected was passed down through the ages. In the days before trade in the tropics introduced cane sugar into the temperate region, honey was the most common sweet available for human food. In some rural districts honey is still gathered as a source of food; some wild honey is still gathered in parts of Africa and Asia; the wild honey from Peru is an important article of export.

Honey has many suggested uses in the menu. In its natural state it may be substituted for jams, jellies or conserves, and because of its sweet taste is especially
adapted to this use. It may be served with bread or hot breads, cereals, pancakes or waffles in this capacity. It may be used as a sweetening agent in beverages, fruits, and vegetables, and may be substituted for sugar and molasses or syrup in cookery. It is also suggested that delicious sandwiches may be made by the addition of honey.

A. Kinds of Honey

Honey is classified in two principal ways (1) source and (2) color.

1. Classification of honeys according to sources

1. Normal honey, from nectaries of flowers

1A

a-Honeys of high purities, high in sugars and relatively low in dextrin, gum and other non-sugars.

(1) Leulose type as mangrove, and sage

(2) Average type, high in sucrose as alfalfa; low in sucrose as buckwheat

b-Honeys of low purity, low in sugars and relatively high in dextrin gums and other non-sugars, as basswood, sumac, poplar, and most tree honeys.

2. Abnormal honey, not from nectaries of flowers, generally high in dextrin gum
and non-sugars

a-Honey dew, from aphids and other insects

b-Coniferous honey, plant exudation but not from nectaries.

2. Classification of honey according to color (1B)

1. Water White
2. Extra White
3. Extra Light Amber
4. Light Amber
5. Amber
6. Dark

This classification of honey is determined by a honey grader.

3. Different colors in honey (2)

The color variation in honey is apparently due to the rapidity of the nectar secretion. When the honey-flow from any given source is rapid, the honey is lighter in color than that from the same source when the honey-flow is slower. Apparently in giving its daily supply of nectar the plant gives off with it a certain amount of coloring matter thus resulting in the difference in the color of the honey in accordance with the abundance of nectar. It is well known that the honey flow is slower in lower altitudes than in high altitudes. In the Imperial Valley, in Southern California, which is below sea
level, the honey flow is slower, though of longer duration, than that in the higher altitudes. When conditions are favorable further south for rapid nectar secretion the honey is whiter than during a poor season. In the event of a very slow honey flow from white or alsike clover the honey is sometimes amber in color, while in the same locality during more favorable conditions it may be classed as water white.

4. Difference in flavors in honey (1A)

The nectar of each kind of flower contains a distinctive combination of oils and other substances which give the blossom its special flavor, and this substance is retained in the honey made from the nectar.

B. Geographical Distribution and Characteristics of Important Varieties of Honey.

1. Eastern honey

a-The white clover belt includes all the states from Maine southward to Virginia and the Allegheny and Piedmont section of the Southern States and all the territory Westward to the plains. White clover is also becoming important in some Western irrigated sections. The white clover belt is the most important honey producing region because it furnishes not only the leading commercial types of honey but more than half of the total crop of the entire country. White clover honey is white, heavy in body, and has a distinct flavor of white clover.
b-Bass wood tree honey is of fine quality and a honey that blends well with white clover. The basswood honey and the white clover honey come from the same region.

c-Other honeys produced in the white clover belt are:

(1) Buckwheat honey - Dark honey of strong flavor very much liked by those familiar with it but very little used outside the section in which it is produced.

(2) Goldenrod honey - A honey highly flavored of a rich, golden color. It is rated as one of the finest fall honeys but is too rich for many who prefer a delicate flavor.

(3) Heartease honey - White or light amber honey with a distinct flavor

(4) Aster honey - Universal fall honey strong amber or dark in color used rarely except for cooking.

(5) Spanish Needle honey - Light golden honey of a very good type. It is considered superior by many.

(6) Sumac Honey - Amber or dark honey with a strong fruity flavor.
(7) Apple honey - Amber honey of a very fine flavor.

(8) Raspberry honey - A white extremely fine flavored honey produced from the wild raspberry.

2. Western Honey

a-Alfalfa honey is the most important source of honey of the Western, Mountain, and Pacific Coast States. It is usually a white honey except in some states where it is a dark amber with a distinctive spicy flavor. Owing to its heavy production throughout the Western States it is an important honey commercially.

b-Sweet clover honey. This is a honey similar to alfalfa but of a superior quality.

c-Mountain Sage honey is a type of honey of much importance commercially. One of the finest honeys in color, density, and flavor. It does not granulate readily.

d-Orange honey is a high ranking commercial honey with a distinctive flavor and aroma. It is grown in large quantities in California and Arizona.

3. Oregon Honey

a-Alfalfa honey produced extensively in Eastern Oregon. It is of a dark amber color in most
sections of Oregon.

b-Fireweed honey produced mainly in the mountains of Northwestern Oregon. It is a clear white in color.

c-Raspberry honey is white in color, of a superior quality and has a raspberry flavor.

d-Maple.

(1) Oregon maple produces an amber honey.

(2) Vine maple produces a red honey.

e-Sweet clover produces a honey light in color, mild in flavor and of a superior quality.

f-French pink or bachelor button produces a dark amber honey with a characteristic greenish tinge. The honey is quite strong in odor and flavor.

C. Production and consumption. (10)

1. Production in the United States.

The bulk of the honey was formerly produced by farmers as a side line, and was handled on the basis of a seasonal product rather than a staple food. The bees were given little attention and the honey produced at relatively little expense. The honey crop was marketed at a low price in the autumn and the stock was usually exhausted by winter. Honey is now being produced extensively as a staple food product. This has been brought about through the influence of commercial beekeeping and the production of honey as a principal occupation. The yield of honey per colony varies
in different years as much as from eighteen pounds to fifty-
eight pounds per colony. There are no accurate statistics
regarding the production and consumption of honey in the
United States. Harold Clay, Marketing Specialist, Bureau of
Agriculture Economics is now collecting statistics on honey,
and his report will be available in a few months. His opin-
ion on the present production of honey is that it runs some-
where between 150,000,000 and 250,000,000 pounds, but that
150,000,000 is nearer correct.

2. Imports and exports of honey (LB)

The total of 3,875,707 pounds of exports
for the calendar year ending December 31, compares with
a total of 10,751,598 pounds, for the calendar year 1928.
The total of 2,516,333 pounds of imports for the calendar
year 1929, compares with a total of 3,043,885 pounds for
the calendar year 1928.

A large part of the imported honey comes
from Porto Rico and Hawaii. The total number of pounds
(1D) being 2,460,485 for the calendar year ending December
1929, leaving a total of 107,752 being shipped in from
other countries of which Canada leads, followed by Greece,
the United Kingdom and France.

A larger part of the exports are shipped
from Los Angeles, a total of 3,903,044 pounds being shipped
from this port. New York is next as an important shipping
port and exported 1,767,172 pounds of honey.

Floyd Buck has estimated that there were 55,000 colonies of bees in Washington last year with an average production of 45 pounds per colony, making a total production in 1929 of 2,475,000 pounds. Todd has estimated that California had 375,000 colonies of bees in 1929 with an average production of 41 pounds per colony and a total of 1,375,000 pounds for that year. The 1929 production in California, however, was less by several million pounds than the output during the two preceding years. Scullen, Associate Professor of the Entomology Department at the Oregon State College has estimated that there are 87,500 colonies of bees in Oregon with an average yield of 30 pounds per colony. The total production being 2,625,000 pounds with the average whole sale price between 7 and 8 cents per pound. He also estimates that 60 per cent of the honey in Oregon is extracted, 30 per cent sold in the comb, and 10 per cent sold as bulk honey.

4. Marketing and containers

A recent survey (10) made in some of the eastern markets has disclosed an interesting number of sizes and styles of containers of honey, which increases the cost of distribution. A survey made in New York of 411 retail stores showed that extracted honey is sold in 36 different sizes and styles of containers which range
from 2 ounces glass jars to 160 pound kegs. One container, a 2 1/2 pound pail accounted for almost one-third of the total quantity sold in these stores, the one pound tin was second in selling the 14 ounce next. Over 56 percent of the total quantity sold was packed in these three containers. The number of containers causes a great variety in price. Honey in tins is from 10 to 15 cents cheaper than honey in glass jars of corresponding size. Honey can be bought much more cheaply by the consumer in 5 pound pails, the price of which averages 23 cents per pound while a 2 ounce jar costs the purchaser an average of 15 cents cost at a rate of $1.20 per pound. The five ounce glass jars average 48 cents per pound.

5. Forms of honey marketing. (1B)

Honey is marketed in three principal forms:

1. Comb honey in one pound section as commonly retailed.
2. Extracted or liquid honey, removed from the comb by means of a centrifugal machine,
3. Bulk honey, consists of comb honey more or less broken and mixed with the liquid honey.
4. Chunk honey is a pleasing form of honey found on the market in most states and is prepared by taking a
chunk of choice comb, packing it in glass jars and filling the remaining space with extracted or strained honey. This is done mostly in fireweed sections as the fireweed honey does not granulate quickly.

D. Composition of Honey (1E)

1. Change in the evaporation of nectar.

In the change of the evaporation of nectar into honey, the water content is lowered at least 20 percent. This is done by the bees before the nectar is deposited in the cell. The nectar is swallowed and regurgitated by the bee until by that movement it is affected by air and heat, causing a sufficient reduction in water content before being deposited in the cell. Another important change which takes place while the nectar is in the honey sac of the bee is the inversion of a considerable part of the sucrose in the nectar, through the action of an inverting enzyme secreted by the bee. Another modification produced in the nectar is the introduction of minute quantities of formic acid. This acid is not found in the pollen and nectar of the flower but is thought to be introduced into the honey by the bee just before the cell is capped. It is also thought to act as a preservative and prevent honey from spoiling.

2. Chemical analysis.
This analysis was made by the Bureau of Chemistry Washington D.C. Over 100 samples of honeys were analysed. The samples were products from fifty varieties of flowers gathered from over thirty-five states. (See Table I on page 13.)

3. The average composition of honey is given as:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>18</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>78</td>
</tr>
<tr>
<td>Including sugar 76% and dextrin</td>
<td>2%</td>
</tr>
<tr>
<td>Mineral and ash</td>
<td>0.22</td>
</tr>
<tr>
<td>Other substances, such as pollen grain gum, bee gum, volatile oil and flavoring substances</td>
<td>3.80</td>
</tr>
</tbody>
</table>

Honey also contains a soluble ferment, diastase, from the digestive secretion of the bees, which saccharifies the starches and dextrin and changes sucrose into glucose and levulose. The chemical change affected by the bees in the sugars is the same as affected by the digestive ferments in the human body. The principal parts may be considered to have undergone the first step in digestion. The carbohydrate division of the Bureau of Chemistry and Soil expect to make a thorough study of the diastase of the American Honey. The amount of diastase in honey is used as a criterion of its purity in Germany. There seems to exist also a correlation between the amount of diastase and the degree to which honey has been heated.
<table>
<thead>
<tr>
<th>Water</th>
<th>Nitrogen matter</th>
<th>Levulose</th>
<th>Dextrose</th>
<th>Sucrose</th>
<th>Gum and wax etc.</th>
<th>Pollen</th>
<th>Other non sugars</th>
<th>Ash</th>
<th>Phosphoric acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>10.00</td>
<td>0.02</td>
<td>30.49</td>
<td>23.52</td>
<td>0.12</td>
<td>trace</td>
<td>1.23</td>
<td>0.02</td>
<td>0.006</td>
</tr>
<tr>
<td>Maximum</td>
<td>33.59</td>
<td>2.02</td>
<td>48.91</td>
<td>42.67</td>
<td>12.91</td>
<td>0.36</td>
<td>2.81</td>
<td>8.82</td>
<td>0.68</td>
</tr>
<tr>
<td>Average</td>
<td>20.60</td>
<td>0.76</td>
<td>38.65</td>
<td>34.48</td>
<td>1.76</td>
<td>0.22</td>
<td>0.71</td>
<td>2.82</td>
<td>0.25</td>
</tr>
</tbody>
</table>
4. Sugars found in honey.

Honey is a wholesome natural food of value in the diet because of its high sugar content. Honey is believed by some to be especially beneficial to persons suffering from digestive or various organic diseases, because the digestive organs are spared the strain of carrying on the chemical inversion necessary when sugar is eaten. Hazel Munsell (5A) states that honey is an excellent form of sweets for the use in the diet of infants and those whose digestion is impaired by illness or disease. The percentage of the different sugars varies in honey as it does in the nectars from which it is made. There are several kinds of sugars present in honey. These are as follows:

A. Cane sugar or sucrose
B. Grape sugar or dextrose
C. Fruit sugar of fructose
D. Melezitose. (1F) A rare trisaccharide occurring in honey made from certain pines and other trees. It is also found in honey dews at a certain season and is thought to cause quicker crystallization of the honey.

Dextrin is present in honey as well as a variety of other substances of small amounts as proteins, volatile oils and other substances of pronounced odor or flavor from the nectars. The proportion of dextrin pre-
sent in nectar honey is so small that it does not effect the food value or cooking value. Honeydew contains so much dextrin it requires special handling in cooking.

5. Minerals found in honey

Honey contains quite a high percentage of minerals which are necessary for health. Some of the minerals are:

A. Magnesia
B. Lime
C. Phosphoric acid
D. Iron

6. Vitamins in honey

Hazell Munsell (5A) states that tests performed on rats and guinea pigs on samples of honey and honey comb gave negative tests for all the vitamins. Experiments performed at Stanford University also agree with her findings in regard to vitamins. (3) At the University of Cincinnati a young Russian, Isay Balinkin (2B) is attempting to prove that vitamin D may be introduced into honey by exposing the bees to ultra violet rays.

7. Fuel value of honey

Table II Calories of honey in comparison with sugar, sirup, and molasses (4)

<table>
<thead>
<tr>
<th>Name</th>
<th>Calories per pound</th>
<th>Meas. wt. in gms.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honey</td>
<td>1481</td>
<td>1 Tb.</td>
</tr>
<tr>
<td>Molasses</td>
<td>1303</td>
<td>1 1/2 Tb.</td>
</tr>
<tr>
<td>Sugar</td>
<td>1615</td>
<td>2 Tb.</td>
</tr>
<tr>
<td>Sirup</td>
<td>1815</td>
<td>1 3/4 Tb.</td>
</tr>
</tbody>
</table>
E. Adulteration of Honey (1E)

The three materials employed most extensively at present in the adulteration of honey are sucrose, or cane sugar, commercial glucose or starch sugar, and invert sugar. Other forms of adulteration such as the addition of water and starch are little used owing to the change these adulterants produce in the appearance of the honey.

Cane sugar may be introduced in two ways, either by addition, or by feeding it to the bees. The addition of sucrose in small amount is very hard to detect. Cane sugar which is introduced into honey by feeding it to the bees is almost impossible to detect, owing to the fact that the bees invert the greater part of the sugar. It has been found that about two-thirds of the cane sugar fed can be inverted.

The addition of commercial glucose has been the most common form of honey adulteration practiced in the past. Glucose is used very largely to improve the appearance of the low grade, very dark colored honey and also to modify the taste of the more rank and strongly flavored natural honeys. It is also used for the purpose of preventing granulation. The addition of only a small amount of glucose will check the crystallization of honey permanently. The adulteration with glucose is made after straining or extracting. Attempts to introduce glucose sirup into honey by feedings have not proved successful,
as the bees refuse to take this sirup as a food. (6) "These adulterations are readily detected by chemical analysis, since genuine honey almost always contains enough levulose to make it levo-rotatory to polarized light, whereas both sucrose and commercial glucose are dextro-rotatory."

F. Granulation of honey. (1E)

It had been the popular idea in the past that granulated honey is adulterated but it has been found that the purest honey will granulate the most quickly. Honey stored in a cool room with a constant temperature will granulate slower than if kept under opposite conditions. A honey with a heavy density will granulate easier than the same variety of honey with a lighter density. Honey contains three sugars: dextrose, sucrose and levulose. Dextrose, being a quickly granulating sugar, begins to form crystals in a short time. Sucrose is present in small amounts and the levulose does not granulate so the amount of dextrose present then determines the crystallization of the honey. Granulation has no effect on the other sugars, flavors or minerals. If the formation of crystals is quick the crystals are small, if the crystals are slow to form they are increased in size. It has been found that exposing the honey to a sharp change in temperature will cause fine crystals.

In decrystallizing honey, heat the honey in a
water bath to 160 or 170 degrees Fahrenheit and let it remain at this temperature until the honey is liquid and free from crystals. Heating honey to a high temperature will change the flavor of the honey, some decomposition of sugar takes place and a darker shade is given the honey. Samples of honey were heated in the laboratory and it was found that heating honey to 220 degrees Fahrenheit did not in any way destroy the flavor of the honey but made it of a slightly thicker consistency and slightly darker in color. Any temperature above this destroyed the flavor of the honey to various extents and changed the consistency of the honey to a large extent, and also darkened it in color.
III EXPERIMENTAL

A. Honey as a Food

A series of experiments were carried out in the foods laboratory at the Oregon State College, using standard tested recipes and substituting honey for sugar, molasses and sirup.

Purpose of Problem:
1. To consider the properties of honey that make it a satisfactory product to be used in cookery.
2. To determine to what extent honey may be used advantageously in the household.
3. To develop recipes for the use of honey in cookery.
4. To formulate rules for substituting honey for sugar, molasses, and sirup.

1. The samples of honey used were:
   Scullen Blend Honey            Corvallis Oregon
   Alfalfa Honey--Bancroft Apiaries    Hermiston Oregon
   Fireweed and White Clover Brands    Pacific Slope Honey Co.
                                          Seattle, Washington

2. The price of honey in Corvallis and comparison with molasses, sugar, and sirup.
   A recent survey made in Corvallis shows an average price of comb honey to be 31 1/2 cents per pound,
honey in glass containers 28 1/4 cents per pound, and that in tin pails averaging 17 3/4 cents per pound.

Table III Comparative Cost of Honey

<table>
<thead>
<tr>
<th></th>
<th>Price per lb.</th>
<th>Price per cup.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>10 cents</td>
<td>5 cents</td>
</tr>
<tr>
<td>Honey</td>
<td>17 3/4 &quot;</td>
<td>11 1/2 &quot;</td>
</tr>
<tr>
<td>Karo</td>
<td>10 &quot;</td>
<td>6 1/4 &quot;</td>
</tr>
<tr>
<td>Molasses</td>
<td>14 &quot;</td>
<td>8 3/4 &quot;</td>
</tr>
</tbody>
</table>

The weight of a cup of honey was standardized by measuring 236.6 cc (number of cubic centimeters in a standard cup) in a graduated cylinder, and weighing this amount in grams. It was found that the Scullen Blend honey weighed 335.5 grams per cup and that the Herminston Alfalfa brand weighed 332.5 per cup. A general score card is given which was used in scoring desserts, beverages, salad dressing, fruits, candy and vegetables. A specific score card is given for batter and dough, and for jelly.

3. Abbreviations used in the experiments are as follows:

c--------------1 cup
Tbs-------------tablespoon
ts-------------teaspoon
gms-------------grams
F-------------Fahrenheit
cc-------------centimeters cubic.
sq-------------square
fg-------------few grains
b.p.------------baking powder
OREGON STATE COLLEGE
SCHOOL OF HOME ECONOMICS

Score Card

Name
Date
Possible score
15

Key
1 very poor 3 good 5 superior
2 poor 4 very good

Samples
1 General Appearance
   Color
2 Consistency
3 Flavor
   pleasing

4. The average weight of the ingredients used:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>gms</th>
<th>Sugar</th>
<th>gms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg white</td>
<td>46</td>
<td>Sugar</td>
<td></td>
</tr>
<tr>
<td>white</td>
<td>30</td>
<td>granulated-200</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>per cup brown</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>sugar-135</td>
<td></td>
</tr>
<tr>
<td>yolk</td>
<td>18</td>
<td>molasses-320</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>honey-335-332</td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td></td>
<td>Baking Powder</td>
<td></td>
</tr>
<tr>
<td>butter</td>
<td>225</td>
<td>Royal-3.07</td>
<td></td>
</tr>
<tr>
<td>lard</td>
<td>220</td>
<td>Soda-3.74</td>
<td></td>
</tr>
<tr>
<td>crisco</td>
<td>200</td>
<td>Salt-4.06</td>
<td></td>
</tr>
<tr>
<td>Flour</td>
<td></td>
<td>crown bread-107</td>
<td></td>
</tr>
<tr>
<td>Fishers pastry</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>crown bread</td>
<td>107</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DESSERTS

Purpose of Problem

1. To determine to what extent honey may be substituted in various desserts, for sugar.
2. To compare the standard recipes using sugar with recipes containing honey in manipulation, length of cooking, consistency, flavor, and sweetness.
3. To determine to what extent honey may be combined with other flavors in these desserts.
4. To determine if on the substitution of honey for sugar in a dessert containing an acid fruit juice there is any change to be made in the volume for volume substitution.

Historical

It has been determined that from eighteen to twenty-five per cent of honey is moisture so for practical purposes in using honey in cooking one-fourth of a cup of liquid is considered to be present in a cup of honey. The amount of moisture in the recipe must be reduced in proportion to the amount of honey used.

The substitution of honey for sugar in these desserts was made volume for volume. One cup of honey was substituted for one cup of sugar.

Series I. A. Standard recipe for cornstarch pudding.

<table>
<thead>
<tr>
<th></th>
<th>milk</th>
<th>cornstarch</th>
<th>sugar</th>
<th>vanilla</th>
<th>salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume 1</td>
<td>1c</td>
<td>1 3/4 Tbs</td>
<td>2 Tbs</td>
<td>1/2 ts</td>
<td>fg</td>
</tr>
<tr>
<td>Wt. in gms.</td>
<td>244</td>
<td>13.5</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Method:

1. Heat milk in double boiler.
2. Mix dry ingredients with a small amount of cold milk.
3. Add mixture to hot milk in double boiler.
4. Stir mixture until it thickens.
5. Cook mixture until it does not have a starchy flavor.
6. Add flavoring.

This recipe makes two servings.

Results:

This recipe makes a pudding standard in general appearance, consistency, flavor and sweetness.

Series I B. Variant—Substitution of blend honey for sugar.

<table>
<thead>
<tr>
<th>milk</th>
<th>cornstarch</th>
<th>honey</th>
<th>vanilla</th>
<th>salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>15 1/2 Tbs</td>
<td>1 3/4 Tbs</td>
<td>2 Tbs</td>
<td>1/2 ts</td>
</tr>
<tr>
<td>wt. in gms</td>
<td>229 cc</td>
<td>13.5</td>
<td>46.9</td>
<td></td>
</tr>
</tbody>
</table>

Method:

The same method of mixing was used as in Series 1A except the honey was added to the hot milk before adding cornstarch.

Results:

1. The pudding made from this recipe was of the same consistency as the pudding made from Series 1A and of
practically the same sweetness.

2. The pudding was slightly darker in color and had a slight honey flavor. The addition of vanilla improved its flavor.

**Series I**

**C. Variant—Addition of cocoa to the recipe substituting honey for sugar.**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume</th>
<th>wt. in gms</th>
<th>cc</th>
</tr>
</thead>
<tbody>
<tr>
<td>cocoa</td>
<td>1 1/2 Tbs</td>
<td>10</td>
<td>229</td>
</tr>
<tr>
<td>milk</td>
<td>1/2 Tbs</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>cornstarch</td>
<td>1 3/4 Tbs</td>
<td>46.9</td>
<td></td>
</tr>
<tr>
<td>honey</td>
<td>2 Tbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vanilla</td>
<td>1/2 ts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>salt</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results:**

1. The pudding made from this recipe was of the same consistency as the pudding made from the standard recipe using sugar and of practically the same sweetness. The chocolate flavor predominated.

2. Vanilla used in this recipe does not improve its flavor but tends to bring out a strong chocolate flavor. It is better to leave the vanilla out.

**Series II**

**A. Lemon Pudding**

**Standard lemon pudding recipe.**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume</th>
<th>wt. gms.</th>
<th>cc</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>1 c</td>
<td>236.6</td>
<td>36</td>
</tr>
<tr>
<td>salt</td>
<td>1/4 ts</td>
<td>11.5</td>
<td></td>
</tr>
<tr>
<td>egg yolk</td>
<td>2</td>
<td>3.5</td>
<td>59</td>
</tr>
<tr>
<td>cornstarch</td>
<td>1 1/2 Tbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>butter</td>
<td>1/2 T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lemon</td>
<td>1 c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sugar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>juice</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results:**

1. The pudding made from this recipe was of the same consistency as the pudding made from the standard recipe using sugar and of practically the same sweetness. The chocolate flavor predominated.

2. Vanilla used in this recipe does not improve its flavor but tends to bring out a strong chocolate flavor. It is better to leave the vanilla out.
Method:

1. Mix cornstarch, sugar and salt.
2. Add to boiling water. Mix well.
3. Cook over direct heat until stiff.
4. Mix a small amount of the hot cornstarch with the egg yolk and stir before adding the yolk to the mixture in the double boiler.
5. Add butter.
7. Add lemon juice.

Results:

This recipe makes a pudding standard in general appearance, consistency, flavor and sweetness.

Series II  B. Variant--Substitution of honey for one-half the sugar.

<table>
<thead>
<tr>
<th>water</th>
<th>salt</th>
<th>egg</th>
<th>corn-</th>
<th>butter</th>
<th>lemon</th>
<th>honey</th>
<th>sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>14 Tbs</td>
<td>1/4t</td>
<td>2-2 1/2 Tbs</td>
<td>1/2 ts</td>
<td>1/2 C</td>
<td>1/2 C</td>
<td></td>
</tr>
<tr>
<td>wt gms</td>
<td>206 cc</td>
<td>36</td>
<td>11.5</td>
<td>3.5</td>
<td>59 cc</td>
<td>166</td>
<td>50</td>
</tr>
</tbody>
</table>

Method:

The same method of mixing the ingredients was used as in Series II A.

Result:

The pudding made from this recipe makes a pudding of the same consistency when cold as the standard lemon sugar pudding. The pudding had a slight honey flavor, but the
honey also seemed to bring out the lemon flavor.

**Series II C.** Variant—Substitution of honey for sugar, volume for volume.

Water salt egg corn- butter lemon honey yolk starch juice

<table>
<thead>
<tr>
<th>Volume</th>
<th>12 Tbs</th>
<th>1/4 ts</th>
<th>2-2 1/2 Tbs</th>
<th>1/2 ts</th>
<th>1 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>wt gms</td>
<td>186</td>
<td>36</td>
<td>11.5</td>
<td>3.5</td>
<td>59</td>
</tr>
<tr>
<td>cc</td>
<td></td>
<td></td>
<td>335</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method:

The same method was used for mixing as in Series I A

Result:

The pudding made from this recipe did not make as stiff a pudding as the Series II A until cold. The flavor of the pudding is strong, almost bitter.

Conclusion:

1. Honey may be substituted volume for volume for sugar in cornstarch pudding without any noticeable change in consistency and sweetness. The addition of honey gives a slight honey flavor.

2. Honey may be substituted volume for volume for sugar in a standard cocoa cornstarch pudding without any change in consistency and sweetness.

3. The addition of vanilla to the recipe substituting honey for one-half the sugar in the standard cornstarch pudding improves its flavor. The addition of the vanilla
to the cocoa cornstarch pudding does not improve its flavor but it has a better flavor without the vanilla.

4. When honey is substituted volume for volume in a standard lemon pudding it becomes strong and almost bitter in taste. Substituting honey for one-half the sugar gives the pudding much better flavor.

5. The moisture must be reduced in the pudding with the addition of honey in proportion to the amount of honey used in the recipe. One-fourth of a cup of liquid is allowed for the moisture in each cup of honey.
APRICOT WHIP

Purpose of Problem:
1. To determine to what extent honey may be substituted for sugar in apricot whip.
2. To compare a standard sugar apricot whip with one containing honey in consistency, manipulation, sweetness and flavor.

Series I  A. Standard recipe for apricot whip.
egg white apricot pulp lemon juice sugar
Volume 1 3/4 C 2 ts 6 Tbs
wt gms 30 205 10 cc 75

Method:
1. Cook the dried apricots that have been soaked over night and run through a seive.
2. Add sugar and cook five minutes or until a thick sirup is obtained. Cool.
3. Beat egg white until stiff.
4. Fold into the beaten egg white the fruit pulp and the lemon juice.
5. Chill one hour before serving.

This recipe makes three servings.

Results:
The whip is a product of standard sweetness, consistency and flavor.
Series I  B. Variant--Substitution of honey for sugar
  egg white apricot pulp lemon juice honey

<table>
<thead>
<tr>
<th>Volume</th>
<th>1</th>
<th>3/4 C</th>
<th>8 ts</th>
<th>6 Tbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>wt gms</td>
<td>30</td>
<td>205</td>
<td>10 cc</td>
<td>121</td>
</tr>
</tbody>
</table>

Method:

The same method was used as in the standard recipe Series IA

Result:

1. The whip was of practically the same consistency, texture, and sweetness as the whip made from the standard sugar recipe. The whip had a slight honey flavor.

2. A slightly larger amount was made than in Series IA

Conclusions:

1. Honey may be substituted for sugar volume for volume, in an apricot whip without any noticeable change in the consistency, texture and sweetness. The addition of honey gives a very pleasing, mild honey flavor.

2. In substituting honey for sugar in an apricot whip a slightly larger amount is made by using the honey.
Meringue

Purpose of Problem:
1. To determine to what extent honey may be substituted for sugar in meringue.
2. To compare the product made from the standard recipe in which sugar was used with the one containing honey, in length of cooking, consistency, flavor and general appearance.

Series I A. Standard recipe for sugar meringue.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg white</td>
<td>1</td>
<td>30 gms</td>
</tr>
<tr>
<td>Sugar</td>
<td>2 Tbs</td>
<td>25 gms</td>
</tr>
<tr>
<td>Vanilla</td>
<td>1/8 ts</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method:
1. Beat egg white until foamy and white but not stiff enough to hold shape.
2. Add vanilla, and sprinkle sugar and salt over surface of the egg whites and beat until mixture is stiff enough to hold shape.
3. Bake in oven at 300°F for about 15 minutes.

Result:
The meringue was a product of standard texture, consistency, general appearance and flavor.

Series I B. Variant--substitution of honey for sugar.
egg white  honey  vanilla  salt
Volume    1         2 Tbs  1/8 ts     fg
wt gms 30          25

Method:

The same method of mixing the ingredients as in the standard sugar recipe Series IA. Vanilla was not added because of the honey flavor desired.

Result:

1. The meringue was similar in sweetness, consistency, and texture to Series IA, but was darker in color and had a very pleasing mild honey flavor.

2. A slightly larger amount of meringue was made.

3. The meringue required a minute longer beating to acquire the same stiffness as in Series IA.

Conclusions:

1. Honey may be substituted for sugar in meringue, volume for volume, without any change in consistency, texture, sweetness of length of cooking. The addition of honey gives a slight honey flavor and makes a product slightly darker in color.

2. A slightly larger amount of meringue was made from the recipe containing honey. (Series IB)

3. In substituting honey for sugar in meringue a longer time is required for beating to acquire the same degree of stiffness.
BATTERS AND DOUGHS

Purpose of Problem:

1. To determine to what extent honey may be substituted for sugar and molasses in batters and doughs.

2. To determine if the addition of honey effects in any way, and to what extent the manipulation, length of baking, temperature of baking, texture and storing quality.

3. To develop from the average batter and dough recipe practical honey recipes.

4. To determine any modifications necessary in a standard recipe on the substitution of honey for sugar and molasses.

Historical:

The size of the pores in baked products (7) is directly proportional to the kind of flour used. The more gluten a flour contains the less beating possible without increasing size of pores or forming tunnels.

Rules of leavening: (8)

1. The steam from one cup of liquid leavens 1 cup flour.

2. Each cup of flour in addition to that leavened by liquid requires 3 teaspoons of baking powder (or the equivalent)

3. 1/2 teaspoon of soda neutralizes one cup of
molasses, or one cup of sour milk.

5. The carbon dioxide produced by neutralizing 1 teaspoon of soda with acid in sour milk, or molasses, is equivalent to the carbon dioxide produced by 4 teaspoons of baking powder.

6. The carbon dioxide from 1/2 teaspoons of baking powder is equivalent in leavening power to air entangled in one beaten egg white.

Daniel and Heisig (9) state "The amount of soda which should be used with molasses varies slightly, but it would seem best to meet the requirement of the least acid. Three fourths of a teaspoon of soda seems an average amount to use with one cup of molasses."

Leach (10) states "We would suggest that if honey is to be used to any great extent in cookery it would be well to purchase it in quantity and determine its acidity. For the occasional cake--the acidity may be disregarded and baking powder used when a quick leavening agent is desired"

It is considered that from eighteen to twenty-five per cent of the honey is liquid so for practical use in cooking one-fourth of a cup of liquid is allowed for the moisture in each cup of honey and the liquid in the standard recipe reduced in proportion to the amount of honey used.
The substitution of honey for sugar was made volume for volume. The substitution of honey for molasses was made without any change in the liquid as molasses is considered to contain as much liquid as honey.

The score card given for plain cakes was also used for the other batters and doughs. Royal Baking Powder and Fischer's Pastry Flour (manufactured at Corvallis, Oregon) were used.

Butter was used as the shortening except in the ginger bread where crisco was used and in the plain cookies where lard was used.

The baking was done in a Hot Point Automatic Electric oven.

**Series I A. Plain Cake**

<table>
<thead>
<tr>
<th>Sugar</th>
<th>Butter</th>
<th>Egg</th>
<th>Egg</th>
<th>Milk</th>
<th>Flour</th>
<th>B.P.</th>
<th>Salt</th>
<th>Vanilla</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 C</td>
<td>1/4 C</td>
<td>1/2 C</td>
<td>1/2 C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 gms</td>
<td>18 gms</td>
<td>30 gms</td>
<td>81 gms</td>
<td>125 gms</td>
<td>4.8 gms</td>
<td>2 gms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Method:**

1. Collect materials and utensils
2. Weigh materials
3. Prepare pan, oiled with fat, line the bottom with oiled paper.
4. Sift weighed dried ingredients three times.
5. Cream fat until smooth and plastic. About two min.
6. Beat egg whites until stiff. (60 revolutions of
egg beater.

7. Add one-third of the sugar and cream one minute.
8. Repeat until all the sugar is added to the fat.

10. Add one-third of the sifted dry ingredients and stir until the flour is dampened. Beat 1/2 minute.
11. Add one-third of the milk and beat 1/2 minute.
12. Repeat until all the milk and flour is added. Beat one minute.
14. Drop pan on table two or three times to cause bubbles to rise.
15. Place in the center of oven rack which has been placed in the third notch from the bottom of the oven.
16. Bake at 350° F for 50 minutes.

Result:

A cake of good general appearance, of a fine even grain and light texture, and a pleasing flavor.

Series I B. Variant--substitution of honey for one-half sugar.
Method:

The same method of mixing the ingredients was used as in Series I A. The honey was added after the sugar and fat were combined (c) and beaten one-half minute.

Result:

The cake was of the same sweetness and texture as in Series I A but with a thicker and browner crust. The cake had a slight honey flavor.

**Series I C.** Variant--substitution of honey for one-half sugar with the addition of soda and the reduction of baking powder.

<table>
<thead>
<tr>
<th>sugar</th>
<th>honey</th>
<th>butter</th>
<th>egg</th>
<th>egg</th>
<th>milk</th>
<th>flour</th>
<th>BP</th>
<th>salt</th>
<th>Van.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>1/2 C</td>
<td>1/4 C</td>
<td>2 1/2 Tbs</td>
<td>1</td>
<td>1</td>
<td>4 1/3 C</td>
<td>1 1/4 C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wt gms</td>
<td>50</td>
<td>84</td>
<td>35</td>
<td>18</td>
<td>30</td>
<td>65.8</td>
<td>125</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 teaspoon of soda produces as much leavening in the presence of heat, moisture, and an acid as 4 teaspoon of baking powder in the presence of heat and moisture. One-half teaspoon of soda neutralized one cup of honey. As one-fourth of a cup of honey was used in the recipe the
soda used was one-eighth of a teaspoon, and the baking powder was reduced one-half teaspoon.

Method:

The same method of mixing was used as in Series I A. The soda was sifted with the dry ingredients.

Result:

The cake was of the same sweetness as Series I A and Series I B but the cake was lighter in texture and with the same flavor as in Series I B.

Conclusions:

1. Honey may be substituted for one-half the sugar in a plain cake recipe without any noticeable change in manipulation, length of baking, sweetness, or texture.

2. The leavening agent used when honey is substituted for sugar may be either baking powder or part baking powder and soda, both giving a satisfactory product. (For the amount of soda used see Series I C)

3. In substituting honey for sugar in a cake recipe the amount of liquid must be reduced in proportion to the amount of honey used. One-fourth of a cup of liquid is allowed for one cup of honey.
Series II  A. Ginger Bread

milk  flour  crisco  sugar  egg  molasses  BP
Volume: 1/2C  1/2C  1/3C  1/4C  1/2  1/2C  11/2 ts
wt: gms  122  150  28  50  24  160  4.8
salt  soda  cinnamon  cloves  ginger.
Vol.: 1/4 ts  1/4 ts  1/4 ts  1/4 ts  1/2 ts

Method:
1. Collect materials and utensils.
2. Weigh materials.
3. Prepare pan, oil with fat, line the bottom of the pan with oiled paper.
4. Sift weighed dry ingredients three times.
5. Cream crisco until smooth and plastic, 2 minutes.
6. Add one-third of the sugar and cream one-half min.
7. Repeat until all sugar is added.
8. Add eggs slightly blended and mix one-half minute.
9. Add molasses and mix well. One minute.
10. Add one-third of the dry ingredients. Stir until blended, one-half minute.
11. Add one-third of the milk, stir until mixed. One minute.
12. Repeat until all the milk and flour is added.
13. Pour into oiled paper.
14. Drop pan on table two or three times to cause bubbles to rise.
15. Place in center of rack which has been put on the
third notch in oven and bake 55 minutes at 350°F.

**Series II**  
B. Variant—Substitution of blend honey for one-half molasses

<table>
<thead>
<tr>
<th>Sweet milk flour</th>
<th>fat</th>
<th>sugar</th>
<th>egg</th>
<th>molasses</th>
<th>honey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol.</td>
<td>1/2 C</td>
<td>1 1/2 C</td>
<td>1/8 C</td>
<td>1/4 C</td>
<td>1/2</td>
</tr>
<tr>
<td>wt gms</td>
<td>122</td>
<td>150</td>
<td>28</td>
<td>50</td>
<td>24</td>
</tr>
</tbody>
</table>

B. P. salt soda cinnamon ginger clove

<table>
<thead>
<tr>
<th>Vol.</th>
<th>1 1/2 ts</th>
<th>1/4 ts</th>
<th>1/4 ts</th>
<th>1/4 ts</th>
<th>1/2 ts</th>
<th>1/4 ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>wt gms</td>
<td>4.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method:

The same method of mixing was used as in Series II A. The honey was substituted volume for volume for the molasses. No reduction was made in the amount of liquid used as molasses contains approximately the same amount of liquid as honey. One-half a teaspoon of soda is used with a cup of molasses and as honey is of the same approximate acidity no change was made in the leavening agents used.

Result:

The ginger bread was of the same sweetness and texture as Series II A but was slightly lighter in color. It had a mild honey flavor but the molasses flavor predominated.
**Series II C. Variant--substitution of honey for molasses.**

Sweet milk flour fat honey egg baking P. salt

<table>
<thead>
<tr>
<th></th>
<th>Vol.</th>
<th>wt gms</th>
</tr>
</thead>
<tbody>
<tr>
<td>sweet milk</td>
<td>1/2 C</td>
<td>122</td>
</tr>
<tr>
<td>flour</td>
<td>1/2 C</td>
<td>150</td>
</tr>
<tr>
<td>fat</td>
<td>1/8 C</td>
<td>28</td>
</tr>
<tr>
<td>honey</td>
<td>1/2 C</td>
<td>167</td>
</tr>
<tr>
<td>egg</td>
<td>1/3 C</td>
<td>24</td>
</tr>
<tr>
<td>baking P.</td>
<td>1/4 ts</td>
<td>4.8</td>
</tr>
<tr>
<td>salt</td>
<td>1/2 ts</td>
<td>50</td>
</tr>
</tbody>
</table>

Soda sugar cinnamon ginger cloves.

<table>
<thead>
<tr>
<th></th>
<th>Vol.</th>
<th>wt gms</th>
</tr>
</thead>
<tbody>
<tr>
<td>soda</td>
<td>1/4 ts</td>
<td>122</td>
</tr>
<tr>
<td>sugar</td>
<td>1/4 C</td>
<td>150</td>
</tr>
<tr>
<td>cinnamon</td>
<td>1/2 ts</td>
<td>28</td>
</tr>
<tr>
<td>ginger</td>
<td>1/4 ts</td>
<td>167</td>
</tr>
<tr>
<td>cloves</td>
<td>1/4 ts</td>
<td>24</td>
</tr>
</tbody>
</table>

Method:

The same method was used as in Series II A. The honey was added in the place of the molasses.

Result:

A ginger bread of the same sweetness, and texture as Series II A but lighter in color and with a mild honey flavor.

**Series II D. Variant--substitution of white clover honey for molasses.** The recipe used was the same as in Series II C. White clover honey was substituted for blend honey.

Result:

The ginger bread was of the same sweetness as in Series II C but was slightly lighter in texture.

**Conclusions:**

1. Honey may be substituted volume for volume
for molasses in ginger bread without any change in the manipulation, length of baking, sweetness, or texture. The ginger bread had the characteristic honey flavor.

2. Honey may be substituted volume for volume for one-half the molasses without any change in the leavening, manipulation, length of baking, sweetness or texture. The bread is slightly lighter in color but with the molasses flavor predominating.

Series III A. Sugar Cookies.

Crown Patent flour (bread) was used in this recipe. Lard was used as the shortening.

flour  sugar  salt  vanilla  B.P.  milk  egg  lard
Vol  4 C  2 C  1 ts  1 ts  4 ts  3/4 C  1  1 C
wt gms 428  400  12.3  183  48  220

Method:

1. Collect materials and utensils
2. Weigh materials
3. Sift dry ingredients
4. Cream shortening until plastic. One-half minute.
5. Add one-third sugar and cream one half minute.
6. Repeat until all sugar is added.
7. Add slightly beaten eggs. Mix thoroughly about one-half minute.
8. Add one-third of dry ingredients. Mix well 30
strokes.

9. Add one-third of the milk. Mix until blended about one-half minute.

10. Repeat until all the flour and milk has been added.

11. Roll to one-fourth inch thickness on floured board.

12. Bake in center of oven at 375° F. for 8 minutes.

13. This recipe makes four dozen cookies.

Result:

The cookies were a standard product in texture, general appearance and sweetness.

Series III B. Variant—substitution of honey for one-half sugar.

flour sugar salt van. b.p. milk egg shortening
Vol. 4c 2c 1 ts 1 ts 4 ts 1/2 c 1 1 c
wt gms 428 400 123 122 48 220

Method:

The same method was used as in Series III A.

Result:

The cookies were of practically the same texture, sweetness and general appearance as in Series III A with a very pleasing honey flavor. The dough was slightly harder to handle than in Series III A.
Series IV  A. Ice Box Cookies

brown butter egg soda flour vanilla salt walnuts sugar

Volume 3/2c 1/4c 1/4 1/4ts 1 1/7c 1/4 ts 1/8 ts 1/4c
wt gms 67 1/2 56 12 115 24

Method:

1. Gather materials and utensils
2. Weigh ingredients
3. Sift weighed dry ingredients together three times
4. Cream butter until plastic. One-half minute
5. Add one-third brown sugar and cream until well mixed, about one-half minute
6. Repeat until all the sugar has been added to the fat. Beat one-half minute.
7. Add egg slightly beaten. Beat one-half minute
8. Add vanilla and mix well
9. Add one-third of dry ingredients and mix well until blended, about one-half minute
10. Repeat
11. Add the chopped walnuts to the last third of the flour and stir until the nuts are covered with flour
12. Add nuts and flour and mix until all the flour is well dampened. Two minutes
13. Put on a slightly floured board. Shape into a roll two inches in diameter
14. Roll in oiled paper and store in ice box over night
15. Cut with a sharp knife into one-fourth inch slices

16. Bake in the middle of oven at 375° F for nine minutes.

Results:

The cookies were standard in size, appearance, shape texture and flavor.

**Series IV B. Variant--substitution of honey for one-half sugar.**

<table>
<thead>
<tr>
<th>brown</th>
<th>butter</th>
<th>egg</th>
<th>soda</th>
<th>walnuts</th>
<th>flour</th>
<th>vanilla</th>
<th>salt</th>
<th>honey</th>
<th>sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volumel(1/4c)</td>
<td>l(1/4c)</td>
<td>l(1/4) ts</td>
<td>l(1/4c)</td>
<td>l(1/2+1Tbs)1/4 ts</td>
<td>l ts1(1/4c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wt gms</td>
<td>33.7</td>
<td>56</td>
<td>12</td>
<td>24</td>
<td>157</td>
<td>84</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method:

The same method of mixing was used as in Series IV A. More flour was used than in Series IV A, because of the additional moisture in the honey, an increase of thirty-two grams of flour being used on the addition of one-fourth cup of honey.

Result:

The cookies were of practically the same size, shape, texture, and general appearance as Series IV A. The cookies had a very pleasing honey flavor.

Conclusions:

1. Honey may be substituted volume for volume
for one-half the sugar in a plain cooky recipe without any change to any noticeable extent in the length of baking, sweetness and general appearance.

2. The cooky dough containing honey is slightly harder to handle than that made from the sugar recipe.

3. The cookies containing honey had a mild honey flavor which was very pleasing.

4. The liquid must be reduced with the addition of honey in proportion to the amount of honey used in the recipe. One-fourth of a cup of liquid is allowed for each cup of honey added.

5. In the ice box cookies there was no liquid used so the flour was increased thirty-two grams when one-fourth of a cup of honey was substituted for one-half of the sugar in the recipe.
**SCORE CARD FOR PLAIN CAKE**

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>Possible Score 55%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 Very Poor 3 Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Poor 4 Very Good 5 Superior</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Samples</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>I General Appearance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>even golden brown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crust</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>thin, not sugary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>even</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II Texture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Even Grain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Velvety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not dry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III Flavor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleasing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Texture of Cakes made with Honey.

I C Made with soda and baking powder.

I B Made with baking powder only.

Series  I C

Series  I B
Purpose of Problem:

1. To determine to what extent honey may be substituted for sugar in the preparation of vegetables.

2. To compare the product from the standard sugar recipe with the product from the recipe in which honey was substituted for sugar in length of cooking, consistency, sweetness and flavor.

Series I  A. Glazed Sweet Potatoes

sweet potatoes brown sugar water butter

<table>
<thead>
<tr>
<th>Volume</th>
<th>6 medium</th>
<th>2/3 c</th>
<th>1/4 c</th>
<th>2 ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>wt gms</td>
<td>90</td>
<td>59</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

Method:

1. Boil whole sweet potatoes
2. Halve lengthwise
3. Make a mixture of the water, sugar and butter
4. Pour over sweet potatoes in a pan.
5. Cook slowly in a moderate oven (400°F) for about 25 minutes
6. Baste potatoes often, until they have a rich glaze

Result:

The sweet potatoes were of standard flavor, sweetness, and texture.
Series I B. Variant—substitution of honey for sugar
sweet potatoes honey water butter
Volume 6 medium 2/3 c 1/6 c 2 Tbs
wt gms 223 39 28
Method:

The same method was used as in Series I A. The amount of liquid in the recipe was reduced in proportion to the amount of honey used. One-fourth of a cup of liquid was allowed for one cup of honey.

Result:

The potatoes were of the same sweetness and texture as Series I A, but a slightly larger amount of sirup was made. The potatoes had a decided honey flavor.

Series I C. Variant—substitution of honey for one-half sugar.

sweet potatoes honey sugar butter water
Volume 6 medium 1/3 c 1/3 c 2 Tbs 1/5 c
wt gms 115 45 28 47
Method:

The same method was used as in Series I A. The liquid in the recipe was reduced in proportion to the amount of honey used, one-fourth of a cup of liquid being allowed for the cup of honey.

Result:

The potatoes were of the same sweetness and texture
as Series I A. The sirup was of the same consistency. The potatoes had a slight honey flavor.

**Conclusion:**

1. Honey may be substituted for sugar in glazed sweet potatoes without any change in the sweetness or texture of the product. The sirup had a decided honey flavor.

2. Honey may be substituted for one-half the sugar in a glazed sweet potato recipe (Series I C) without any change in the sweetness or texture but with a mild honey flavor.

3. The amount of liquid in the recipe must be reduced on the substitution of honey in proportion to the amount of honey used. One-fourth of a cup of liquid is allowed for each cup of honey.
Purpose of Problem:

1. To determine if honey may be substituted for sugar in beverages without any deleterious effect on the flavor or sweetness.
2. To determine to what extent honey may be substituted for sugar in beverages.

Series I  A. Coffee

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume</th>
<th>Weight (gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee</td>
<td>1/2 c</td>
<td>944 cc</td>
</tr>
<tr>
<td>Water</td>
<td>4 c</td>
<td></td>
</tr>
</tbody>
</table>

Method:

1. Place coffee in a percolator
2. Pour on cold water and percolate 7 to 10 minutes.

In judging the beverages two cups full were taken and one cup sweetened with sugar and the other sweetened with the same amount of honey, and a comparison was made between the two cups.

Substituting honey for sugar in coffee gave the same sweetness and a pleasing honey flavor.

Series II  A. Tea

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume</th>
<th>Weight (gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black tea</td>
<td>3 ts</td>
<td>1416 cc</td>
</tr>
<tr>
<td>Water</td>
<td>6 c</td>
<td></td>
</tr>
</tbody>
</table>
Method:
1. Place tea in freshly scalded earthen tea pot.
2. Pour boiling water over it.
3. Steep three minutes. Strain.
Sugar and honey were added as in Series I A.

Result:
Substituting honey for sugar in tea gave the same sweetness and a very pleasing honey flavor.

**Series III A. Cocoa**

<table>
<thead>
<tr>
<th>Volume</th>
<th>cocoa</th>
<th>sugar</th>
<th>water</th>
<th>salt</th>
<th>scalded milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Tbs</td>
<td>1/4 c</td>
<td>1/2 c</td>
<td>fg</td>
<td>3 1/2 c</td>
<td></td>
</tr>
<tr>
<td>wt gms</td>
<td>50</td>
<td>118 cc</td>
<td>854</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method:
1. Cook cocoa, sugar and salt and water together until a thick sirup is formed (10 minutes.)
2. Add the scalded milk and cook in a double boiler 20 minutes.
3. Beat with egg beater until frothy.

Result:
The cocoa was of standard strength and sweetness.

**Series III B. Variant—substitution of honey for sugar.**
The same method of mixing was used as in Series III A.

Result:

The cocoa was of practically the same sweetness as in Series III A. and had a very pleasing honey flavor.

**Series IV A. Lemonade**

<table>
<thead>
<tr>
<th>lemon juice</th>
<th>sugar</th>
<th>water</th>
<th>ice cube</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 l/2 ts</td>
<td>1 c</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Result:

A lemonade of standard sweetness and strength.

**Series IV B. Variant—substitution of honey for sugar.**

<table>
<thead>
<tr>
<th>Lemon juice</th>
<th>honey</th>
<th>water</th>
<th>ice cube</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 l/2 ts</td>
<td>1 c</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Result:

A lemonade of standard sweetness and strength.
Method:

The same method of mixing was used as in Series IV A.

Result:

The lemonade was quite dark in color and had a very decided honey flavor and was of the same sweetness as the standard sugar lemonade.

Series IV C. Variant--substitution of honey for one-half sugar.

lemon juice water honey sugar ice cube.

| Volume | 1 | 1 c | 2 1/4 ts | 2 1/4 ts | 1 |
| wt gms | 40 cc | 236.6 | 19 | 11.5 |

Method:

The same method was used as in Series IV A.

Result:

The lemonade was lighter in color than in Series IV B but was slightly darker than in Series IV A. The lemonade was of the same relative sweetness as the other recipes.

Conclusions:

1. Honey may be substituted volume for volume for sugar in coffee, tea, and cocoa giving a beverage of the same relative sweetness and with a very pleasing honey flavor.

2. Honey may be substituted volume for volume for sugar in lemonade but makes a darker beverage with a
decided honey flavor. The honey flavor predominated.

3. Honey may be substituted for one-half the sugar in lemonade and gives a lemonade slightly darker in color, and with a mild honey flavor. This lemonade was much better in flavor than the one substituting honey for the whole volume of sugar.
FRUIT SALAD DRESSING

Purpose of Problem:

1. To determine to what extent honey may be substituted for sugar in a fruit salad dressing.

2. To compare the product made from the standard recipe containing sugar with the product containing honey in consistency, texture, sweetness, flavor and length of cooking.

Series I A. Standard recipe for fruit salad dressing

<table>
<thead>
<tr>
<th></th>
<th>lemon juice</th>
<th>pineapple juice</th>
<th>orange juice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>3 Tbs</td>
<td>6 Tbs</td>
<td>3 Tbs</td>
</tr>
<tr>
<td>wt gms</td>
<td>47 cc</td>
<td>94 cc</td>
<td>47 cc</td>
</tr>
<tr>
<td>water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cornstarch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sugar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>egg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume</td>
<td>1/4 c</td>
<td>2 Tbs</td>
<td>1/2 c</td>
</tr>
<tr>
<td>wt gms</td>
<td>59 cc</td>
<td>15.4</td>
<td>100</td>
</tr>
</tbody>
</table>

Method:

1. Mix dry ingredients

2. Add fruit juices and water slowly. Stir until smooth.

3. Cook in double boiler 15 minutes

4. Pour mixture over slightly beaten egg.

5. Reheat for one minute. Stirring constantly.

6. Thin with whipped cream if desired.

7. Serve with fresh fruit.
Result:

The salad dressing was a product of standard consistency, sweetness and flavor.

**Series I B. Variant—substitution of honey for sugar.**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume</th>
<th>Weight</th>
<th>Mls</th>
<th>Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>lemon</td>
<td>2 Tbs</td>
<td>47 cc</td>
<td>47 cc</td>
<td>29.5</td>
</tr>
<tr>
<td>pineapple</td>
<td>6 Tbs</td>
<td>3 Tbs</td>
<td>3 Tbs</td>
<td>15.4</td>
</tr>
<tr>
<td>orange</td>
<td></td>
<td>1/8 c</td>
<td>1/8 c</td>
<td>167</td>
</tr>
<tr>
<td>water</td>
<td></td>
<td></td>
<td>2 Tbs</td>
<td>60</td>
</tr>
<tr>
<td>corn juice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pineapple juice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lemon juice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>corn starch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Method:**

The same method of mixing was used as in Series I A. The amount of liquid in the dressing was reduced in proportion to the amount of honey used. One-fourth of a cup of liquid is allowed for each cup of honey.

Result:

1. The dressing was of practically the same sweetness, and consistency as that made by the recipe Series I A.

2. The dressing had a distinct honey flavor which blends well with oranges and peaches.

**Conclusions:**

1. Honey may be substituted volume for volume for sugar in a fruit salad dressing without any noticeable change in the consistency or sweetness, but with a decided honey flavor.
2. The recipe in which honey was substituted for sugar was reduced in liquid in proportion to the amount of honey used, allowing one-fourth of a cup of liquid to each cup of honey.
FRUITS

Purpose of Problem:

1. To determine to what extent honey may be substituted for sugar in fruits.

2. To compare the product from the sugar recipe with the product from the one in which honey was substituted for sugar in sweetness and flavor.

3. To determine to what extent honey may be combined with fruit flavors.

Series I

A. Standard recipe for baked apples.

<table>
<thead>
<tr>
<th>Apple</th>
<th>Sugar</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2 Tbs</td>
</tr>
</tbody>
</table>

wt gms

| 25 | 49 |

Method:

1. Core apple

2. Place in bake pan

3. Pour sugar in the center of the apple

4. Pour water over apple and bake in a moderate oven. 400° F for about 25 minutes.

Result:

The apples were a product of standard sweetness and flavor.
Series I B. Variant—substitution of honey for sugar

apple  honey  water

Volume  1  2 Tbs  1/5 c
wt gms   44   42 cc

Method:

The same method was used as in Series I A. The amount of liquid was reduced in proportion to the amount of honey used. One-fourth of a cup of liquid is allowed for each cup of honey.

Result:

The baked apple was of relatively the same sweetness as in Series I A out with a strong honey flavor and the loss of the apple flavor. The skin of the apple was slightly toughened.

Series I C. Variant—substitution of honey for one-half sugar.

apple  honey  sugar    water

Volume  1  1 Tbs  1 Tbs 1/4 c scant
wt gms   21   12.5  47

Method:

The same method was used as in Series I A and in Series I B.

Result:

The same sweetness as in Series I A and in Series I B. A slight honey flavor.
Conclusions:

1. Honey may be substituted volume for volume for sugar in baked apples without any change in the relative sweetness. When honey is substituted for all the sugar the apple flavor is lost and the honey flavor predominates. The skin is also slightly toughened.

2. Substituting honey for one-half the sugar in baked apples gives a better product in flavor and texture.

3. The liquid in the standard recipe (Series I A) was reduced in proportion to the amount of honey used. One-fourth of a cup of liquid being allowed for each cup of honey.

Series II A. Grape fruit

A grape fruit was prepared with sugar and another in which honey was substituted for sugar, volume for volume.

Result:

The grape fruit in which honey was substituted for sugar was of the same sweetness as the one using sugar and with a slight and pleasing honey flavor.

Conclusion:

Honey may be substituted for sugar in grape fruit without any change in sweetness and adds a slight, pleasing honey flavor.
FUDGE

Purpose of Problem:

1. To determine to what extent honey may be substituted for sirup in fudge.
2. To compare the product from the standard recipe using sirup with the product from the recipe using honey in length of cooking, length of beating, consistency and flavor.

Series I A. Standard recipe for fudge.

<table>
<thead>
<tr>
<th>sugar</th>
<th>chocolate</th>
<th>salt</th>
<th>vanilla</th>
<th>butter</th>
<th>milk</th>
<th>sirup</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 c</td>
<td>1 sq</td>
<td>1/4 ts</td>
<td>1 ts</td>
<td>1 Tbs</td>
<td>1 c</td>
<td>1 ts</td>
</tr>
<tr>
<td>wt gms</td>
<td>400</td>
<td>28.5</td>
<td>15.8</td>
<td>244</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Method:

1. Melt the chocolate over hot water in the pan the candy is to be cooked in.
2. Add sugar, salt, sirup and milk. Mix well.
3. Cook over an open flame to the soft ball stage or 112° C.
4. Add butter and vanilla
5. Cool to 80° C or luke warm stage.
6. Beat until light and creamy (10 minutes.)
7. Spread out in buttered platter.

Result:

The fudge was a standard product in consistency, flavor and general appearance.
Series I B. Variant--substitution of honey for sirup.

<table>
<thead>
<tr>
<th>sugar</th>
<th>chocolate</th>
<th>salt</th>
<th>vanilla</th>
<th>butter</th>
<th>milk</th>
<th>honey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume 2 c</td>
<td>1 sq</td>
<td>1/4 ts</td>
<td>1 ts</td>
<td>1 Tbs</td>
<td>1 c</td>
<td>1 Ts</td>
</tr>
<tr>
<td>wt gms</td>
<td>400</td>
<td>28.5</td>
<td>15.8</td>
<td>244</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Method:

The same method of making was used as in Series I A.

Result:

The fudge was of the same consistency and general appearance as in Series I A but had a slight honey flavor.

Series I C. Variant--substitution of honey for sirup in larger amounts.

<table>
<thead>
<tr>
<th>sugar</th>
<th>chocolate</th>
<th>salt</th>
<th>vanilla</th>
<th>butter</th>
<th>milk</th>
<th>honey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume 2 c</td>
<td>1 sq</td>
<td>1/4 ts</td>
<td>1 ts</td>
<td>1 Tbs</td>
<td>1 c</td>
<td>2 Ts</td>
</tr>
<tr>
<td>wt gms</td>
<td>400</td>
<td>28.5</td>
<td>15.8</td>
<td>244</td>
<td>46.9</td>
<td></td>
</tr>
</tbody>
</table>

Method:

The same method was used as in Series I A but the temperature of cooking was raised to 114° C.

Result:

The fudge was of the same consistency and general appearance as in Series I A and Series I B but required a longer time (5 minutes) for beating and had a slightly stronger honey flavor.

Conclusions:

1. Honey may be substituted volume for volume
for sirup in fudge without any change in the consistency and general appearance. The fudge made using honey had a slight, pleasing honey flavor.

2. A slightly larger amount of honey may be substituted for sirup in fudge but requires a higher degree of cooking and a longer time of beating, and also has a stronger flavor of honey.
POPCORN BALLS

Purpose of Problem:
1. To determine if honey may be used successfully in making popcorn balls.
2. To formulate a recipe for honey popcorn balls.

Series I  A. Honey popcorn balls.

<table>
<thead>
<tr>
<th>honey</th>
<th>popcorn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>1/2 c</td>
</tr>
<tr>
<td>wt gms</td>
<td>167</td>
</tr>
</tbody>
</table>

Method:
1. Heat the honey to 123° C
2. Pour over the popcorn
3. Form into balls

Result:
The balls were a standard product in general appearance and consistency, with a very pleasing honey flavor. The balls were stored for several days and still retained their shape and flavor.

Conclusion:
Honey may be successfully used in making popcorn balls.
JELLY

Purpose of Problem:

1. To determine to what extent honey may be substituted for sugar in jellies.
2. To compare the product from the recipe using sugar with the one containing honey in sweetness, flavor and consistency.

Historical:

Five things are necessary for formation of a standard jelly—pectin, acid, sugar, water, and possibly calcium salt.

Cooked fruit juice contains more pectin than uncooked juice. Over-cooking fruit juice converts pectin into pectic acid and alcohol. Therefore jelly fails to set.

Test for Pectin:

Take one tablespoon of fruit juice and one tablespoon of alcohol, if a large amount of pectin is present a gelatinous mass is formed, if a small amount of pectin is present it will collect in flaky particles.

The quantity of sugar added to the juice effect the texture, flavor and the yield of jelly. Too much sugar added results in failure to jell. Too small amount of sugar results in a tough jelly.

The color of jelly varies with the amount of sugar added and the kind of sugar used.
A perfect jelly (12) is clear, bright and tender and when cut with a knife has a clean surface, and does not stick to knife, and holds its shape when turned from a glass.

Jelly test: (12)

Take a small amount of juice on a spoon and allow it to drop from the side of the spoon. When the drops flow together and drop from the spoon in a sheet the jelly is done. The temperature test is from 104° to 106° F.

Grape juice was used from the Horticulture Department of the Oregon State Agricultural College.

Series I A. Grape Jelly

<table>
<thead>
<tr>
<th>Sugar</th>
<th>Grape Juice</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/3 c</td>
<td>1 c</td>
</tr>
<tr>
<td>135 gms</td>
<td>236.6 cc</td>
</tr>
</tbody>
</table>

Method:

1. Add sugar to grape juice
2. Stir until sugar is dissolved
3. Cook over open flame until the jelly test is given (dropping of the juice off the spoon in sheets or to 106° F.)
4. Pour into scalded jelly glasses
5. Cool and cover with paraffine.

Result:

A jelly of standard consistency sweetness and flavor.
Series I  B. Variant--substitution of honey for sugar.

honey   grape juice

Volume  2/3 c   1 c
wt gms   223    236.6 cc

Method:

The same method was used as in Series I A. The honey was added in place of the sugar.

Result:

A jelly of practically the same sweetness but of a softer consistency than Series I A. A strong honey and grape flavor. A larger amount was made than in Series I A.

Series I  C. Variant--substitution of honey for one-half sugar.

honey   sugar   grape juice

Volume  1/3 c  1/3 c   1 c
wt gms  112    67     236.6 cc

Method:

The same method was used as in Series I A.

Result:

The jelly was of practically the same sweetness as in Series I A but of a slightly softer consistency and having a slight honey flavor. A slightly larger amount of jelly was made than in Series I A but less than in
Series I B.

**Series I D.** Variant—substitution of honey for one-fourth sugar.

<table>
<thead>
<tr>
<th>honey</th>
<th>sugar</th>
<th>grape juice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/6 c</td>
<td>1/2 c</td>
<td>1 c</td>
</tr>
</tbody>
</table>

| wt in gms | 56 | 100 | 236.6 cc |

**Method:**

The same method was used as in Series I A.

**Result:**

The jelly was of the same sweetness and of practically the same consistency as Series I A and had a very slight honey flavor.

**Conclusions:**

1. Honey may be substituted volume for volume for sugar in grape jelly without any change in the sweetness but gives a jelly of a softer consistency, with a strong honey and grape flavor. A larger amount of the jelly is made.

2. Honey may be substituted volume for volume for one-half the sugar in jelly and gives a jelly of the same sweetness, slightly softer in consistency with a slight honey flavor. A slightly larger amount is made.

3. Honey may be substituted for one-fourth of the sugar and produces a jelly of the same sweetness and of practically the same consistency with a slight honey
flavor.

Due to shortage of time and the scope of the problem no more work was done on jellies using any other kind of juice. It is suggested that honey may be used very successfully with other juices in making jelly.
OREGON STATE COLLEGE  
SCHOOL OF HOME ECONOMICS  
Score Card for Jelly

Name___________________________ Date___________________

Possible score 35

Key:

1 very poor  
2 poor  
3 good  
4 very good  
5 superior

<table>
<thead>
<tr>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I General Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
</tr>
<tr>
<td>Clarity</td>
</tr>
<tr>
<td>Lack of crystals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin</td>
</tr>
<tr>
<td>Sugary</td>
</tr>
<tr>
<td>Thick</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III Flavor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasing</td>
</tr>
</tbody>
</table>


General Conclusions:

Honey may be successfully substituted volume for volume for sugar, molasses and sirup in varying proportions in desserts, meringues, batters and doughs, beverages, salad dressings, fruits, vegetables, candy and jelly. In substitution of honey for sugar the liquid in the recipe must be reduced in proportion to the amount of honey used. Honey contains from eighteen to twenty-five per cent of liquid, therefore for practical cooking purposes one-fourth of a cup of liquid is allowed for each cup of honey. In substituting honey for molasses no reduction of the liquid is necessary as molasses contains practically as much liquid as honey. The leavening may remain the same in each case although a slightly lighter product was obtained in substituting a small amount of soda for the baking powder in the substitution of honey for sugar. (See batters and doughs Series I C.)

Summary:

Honey has been important as a food as far back as any record has been kept. Each locality or country has its varieties of honey with certain definite characteristics, differing in color, flavor, and consistency. The production of honey is steadily increasing as the industry is being commercialized and the production of honey becoming a principal occupation. The United States exports and imports a large amount of honey. The imported honey
comes mostly from Hawaii and Porto Rico and is of an inferior quality to that produced in the United States. The price of honey is slightly higher than that of sugar, sirup, or molasses, due to some extent to the large variety of containers in which honey is retailed.

Few realize the importance of honey as a food in the diet. It is thought to be especially beneficial to those with impaired digestion as the sugars found in honey are already in a predigested state and the digestive organs are spared the strain of carrying on the chemical inversion necessary when sugar is eaten. Honey also contains minerals that are so necessary in the diet. Honey may be used in its natural state as a substitute for jams, jellies or conserves, or it may be used advantageously in cookery. It may be successfully substituted for sugar, molasses and sirup in varying proportions in desserts, meringues, catters and doughs, beverages, salad dressings, fruits, vegetables, candies and jellies.
BIBLIOGRAPHY

   A. Bureau of Entomology, Bulletin No. 75
   C. Farmers Bulletin No. 685
   D. Market News Service. Exports and Imports of Honey Semimonthly Report during Calendar Year ending Dec. 31, 1929
   E. Bureau of Chemistry. No. 110
   F. Farmers Bulletin No. 1039 Commercial Comb-Honey Production

2. American Bee Journal
   A. January 1924
   B. 1929

3. Biological Chemistry Journal 1920 Page 113


5. Year Book of Agriculture
   A. 1920
   B. 1929


BIBLIOGRAPHY CONT'D.


10. Leach, Albert 1913, Food Inspection and Analysis, P. 332. N.Y.J. Wiley and Sons.


14. Sherman, Henry 1921, Food Products


16. Pamphlets and Bulletins


E. Kellogg Co. Home Economics Department. Cooking with Honey. Do You Like Honey? Do You Use
BIBLIOGRAPHY CONT'D.

Honey?
F. American Honey Producers League. 1921, Honey, How and When to use it.
G. University of Arizona Experimental Station.
Honey Vinegar.
H. Agricultural Experimental Station, Michigan State College. Honey Fermentation.
I. Agricultural Experimental Station, Purdue University. Honey, Its uses in the Home.


