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PRINCIPLES OF MAKING FRUIT-JELLIES

By N. E. Goldthwaite

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By N. E. Goldthwaite

RESEARCH, WHAT IS IT?

In these days when we are hearing so much about the need of research—scientific research—it is worth while to stop to inquire what it is. Research is asking direct questions of Nature to learn her secrets. Such questions are asked by experiment—experiments so clear-cut that Nature can give an intelligible answer. She never disregards our experiments—never fails to answer our questions; but if we put them bunglingly, her answers will be likewise bungling. The scientist strives to ask his questions so clearly—to make his experiments so exact—that Nature can answer but one point at a time, and can make that answer so definite that there is no mistaking her meaning. Humanity learned long ago that fire burns, but only recently has it learned that deaths from burns ensue because of poisons produced by the burned flesh. The scientist's curiosity about Nature is insatiable. He puts to her most difficult questions. Step by step, he wrests her secrets from her. Gradually he pieces her answers together, till today he harnesses the lightning, he treads the air, he throws his voice to earth's limits. Each achievement but reveals new fields to conquer, more questions to ask.

The Questionings of Early Humanity

All this questioning of Nature down through the ages, began with the inveterate questions of early man and early woman, began with their all-important questions of food and warmth. What could they eat?—How could they protect their naked bodies? Only by "trial and error" could they get answers to these questions. Only thus did they slowly learn what they might and what they might not safely eat. Only thus could they learn how to prepare animal skins for clothing, how to twist plant and animal fibers into strands and finally to interlace (weave) these into body coverings. Early woman especially had an unquenchable curiosity about all things—for must she not feed her little ones, must she not keep them warm? According to Mason[1] early man was the hunter, the fisher, the fighter, his was the militant sex. Early woman was the first agriculturist, the food-preserver, the skin-dresser, the basket-maker, the weaver, the potter, the burden-bearer, the artist, the linguist, the teacher—first of all these, and more; and all because of her primary responsibility for her little ones; hers was the industrial sex. Always she was a producer of wealth.

Present Tendencies

In those elder days of the race, women were observers, planners, doers. Today, in this age of machinery, the manufacturer of any article or appliance for woman's use, considers he has reached the

[1] Otis T. Mason, Woman's Share in Primitive Culture.

acme of perfection in it when he can advertise it as "so simple a child can use it"—and women don't resent the imputation! Does the expression epitomize humanity's judgment of us? Is it true that we have become so incapable, so unthinking? Every child is a born experimenter—his first laboratory, his mouth. But how quickly under present-day guidance most children lose this spirit—learn to hide their ignorance, and henceforth to wish to be "told!"

STORY OF THIS BULLETIN

This bulletin is one of the results of an extended research into the "why" of jelly-making, carried out by the writer in 1908-11 at the University of Illinois, and in 1923-24 at the Colorado Agricultural College. The results of the researches of 1908-11 were published in the Journal of Industrial and Engineering Chemistry (June, 1909 and Nov. 1910); in Good Housekeeping (July, 1909); and in a University of Illinois Bulletin for housekeepers: Principles of Jelly-Making (first edition 1911, fifth edition 1917).

The present bulletin is written especially for the women of Colorado. Occasionally the author quotes verbatim from her earlier writings but in the main this is an entirely new production. Doubtless, many women reading it will discover repeatedly statements of facts which they "know already." Some of those facts have been handed down from generation to generation as a part of our common stock of knowledge—a legacy from the questionings of women of generations past. Many of those facts which have been finding a place in the "Woman's Column" during the past fourteen years, when traced to their source, are found to have had their origin in the author's researches of 1908-11. Her early publications seem to have furnished much "copy" for prolific writers of woman's columns, as well as much information for manufacturers.

With just respect for all intelligent women, who wish to grow in their unique profession of home-making, the author, in this bulletin, indicates by frequent foot-notes, the original sources of information for the various statements which she makes. Some women will be interested to look up these references. When the authorship of such references is omitted, the author thereof was the present writer.

DISCUSSION

PRINCIPLES VS. RECEIPTS, OR RECIPES

As in her earlier bulletin (1911) the author has tried to make as clear as possible the fundamental principles on which the science and art of jelly-making rest, rather than to give receipts (or recipes). If the juices of given fruits were identical in strength year after year, or if the housekeeper had means of analyzing them chemically, it would be possible to set down definite rules for various fruit-jellies. But with the variations that occur in Nature's own productions, it is better to grasp fully the principles of the process rather than to rely upon rule-o'-thumb receipts. The woman who is experienced and intelligent in her cookery, rarely follows

any receipts or recipe exactly; almost unconsciously she modifies any rule according to the variations she perceives in the materials she is handling. She says she uses "common sense"; in reality she applies the principles of cooking that she has gradually learned by experience and has made a part of her mental equipment.

THE IDEAL FRUIT-JELLY

"Ideal fruit-jelly is a beautifully colored, transparent, palatable product obtained by so treating fruit-juice that the resulting mass will quiver, not flow, when removed from its mold; a product with texture so tender that it cuts easily with a spoon, and yet so firm that the angles thus produced retain their shape; a clear product that is neither syrupy, gummy, sticky, nor tough; neither is it brittle and yet it will break, and does this with a distinct, beautiful cleavage which leaves sparkling characteristic faces. This is that delicious, appetizing substance, a good fruit-jelly[2]." Such ideal fruit-jelly, as every housewife knows, is the happy result of the skillful combination and concentration (boiling down) of a suitable fruit-juice and sugar.

ESSENTIAL CONSTITUENTS OF FRUIT-JELLIES

Fruit-juice is a water solution of fruit flavoring materials, sugars, certain acids, and pectin. This last substance, pectin, is the gelatinous substance of fruit-juices which "jells"; without pectin no fruit-jelly can be made, but even with it, a jelly will not "jell" properly without fruit-acids and added sugar. Currant juice is especially rich in pectin and acid, hence it is one of our most desirable fruits for jelly. In currants nature supplies a juice rich in pectin, and the necessary acid; the housewife adds the correct proportion of sugar, boils down the solution to the proper concentration—that is, evaporates off any unnecessary water—result, an ideal jelly.

PECTIN

Who among our foremothers discovered that fruit-juice with sugar dissolved in it, when concentrated to a certain optimum consistency, would yield a jelly on cooling, no one knows. Probably it was the discovery of no one person, but was the result of the observations of many, just as are most so-called discoveries and inventions.

Discovery of Pectin

However, we do know that a hundred years ago, Braconnot[3], a French chemist, while examining chemically various vegetables and fruits, did discover the jellifying principle of fruit-juices, and that he named it pectin (from the Greek word *pektis,* meaning coagulum). Braconnot published the story of his researches, that led to the discovery of pectin, in 1825 in the French Annals of Chemistry and Physics, where we may yet read it.

2. Goldthwaite, Principles of Jelly Making, First Edition, p. 1, (1911). University of Illinois.

3. Braconnot, Annales de Chimie et de Physique, (2) 28, p. 173 (1825).

Test for Pectin

When you wish to know whether or not a fruit-juice contains pectin, put a tablespoonful of the cold juice into a glass and add to it a tablespoonful of alcohol (either denatured or wood alcohol); if a thick, gelatinous precipitate forms, the juice contains pectin. You will be interested to take a teaspoon and try to pick up this gelatinous mass of pectin. If you choose you may economize both juice and alcohol by taking only a teaspoonful of each instead of a tablespoonful, and when you get used to the test you will find you can interpret the result from the smaller amount just as well as from the larger. Braconnot, who discovered this test, also discovered that many other substances will precipitate pectin, but the alcohol test is the easiest one for the housekeeper to use. By this test the housekeeper will soon discover that different fruit-juices contain very different amounts of pectin; sometimes none at all. If pectin is present in a fruit-juice, jelly can be made from that juice; otherwise not, unless pectin from some other fruit is supplied.

Pure Pectin

Pectin when precipitated and separated from fruit-juice, and carefully purified, is a "nearly colorless, transparent solid of insipid taste"[4] which can be easily crushed to a white powder "somewhat starch-like in appearance"[5]—quite unlike in appearance the thick brown liquids which taste strongly of apple and which, as fruit pectin, are on the market today for the use of housekeepers.

Composition of Pectin

Scientifically speaking, pectin is a vegetable substance akin to starch in its nature,[6] and like starch it is composed of the elements carbon, hydrogen and oxygen. Notwithstanding its jelling properties, chemically it is not at all like gelatine with which we are so familiar. Gelatine is of animal origin, and in addition to the elements named above, nitrogen enters into its composition; it is a protein,[7] but an incomplete one—that is, it is incapable of fulfilling all the functions of a protein food.

ACIDS OF FRUITS

Fruit-acids play a very important part in jelly-making. So the intelligent woman wishes, naturally, to know something about them. By the term "acid," we mean primarily a substance with a sharp or tart taste. The word "acid" comes from the Latin word *acer*, meaning sharp. Acids are the substances which give edge to the taste of fruits and their juices. When separated from the fruits producing them, these plant acids are found to be beautiful, white, crystalline, solid substances; and as you would easily guess, since they are found in fruit-juices, they are very soluble in water.

4. Goldthwaite, Jour. of Ind. and Eng. Chem. I, p. 339 (June 1909).
5. Goldthwaite, Jour. of Ind. and Eng. Chem II, p. 461, (Nov. 1910).
6. Fremy, Annalen der Chemie, 64, p. 383, (1847).
7. Mathews, Physiological Chemistry, 3d Edition, p. 636.
   Potatoes from the Housekeeper's Standpoint, Part III, Home Economics Dept., Colo. State Agricultural Col.

Citric, Malic and Tartaric Acids

We are all familiar with the occurrence of several of these fruit-acids, though we may not know their names. Citric acid occurs especially in lemon juice, and our relish for lemonade is due primarily to this acid. Citric acid is also found in oranges, but less plentifully than in lemons. Malic acid is particularly the acid of apples. It gets its name from the Greek word *malon*, meaning apple. Apples owe their delicious tartness to malic acid. Tartaric acid, another very important fruit-acid, is the principal acid of grapes and currants. Every housekeeper knows cream-of-tartar as one of the constituents of some baking-powders, and she probably knows that grapes furnish this cream-of-tartar (one of the potassium[8] salts of tartaric acid). The term tartaric comes from another Greek word, *tartaron*, meaning the incrustation on the sides of wine casks.

Importance

These three acids—citric, malic and tartaric—are our most important fruit-acids, and it is to varying amounts of these that the acidity or tart taste of most of our fruits is due. The rôle of these acids in jelly-making is of great importance, and will be considered further on. It should be mentioned here, however, that fruit-acids or vegetable acids, are not of the type which tend to render the body fluids acidic[9]. Rather because of the strong basic elements combined with them, they help to render the body fluids slightly basic or alkaline[10]—just as Nature wishes these fluids to be—hence, their great importance to the human body.

CHOICE OF FRUITS FOR JELLIES

A fruit which yields a juice rich in pectin, and sufficiently rich in some fruit-acid to give it tartness, is one of Nature's own for jelly-making. Such fruits are currants, grapes and crabapples especially. It is a matter of long experience with housekeepers, that a fruit partially ripened is superior to its fully ripened fruit for jelly-making. This is because pectin slowly disappears from fruit during the ripening process. Hence, fruits not wholly ripe,[11] but ripened sufficiently for their characteristic fruit flavors to be developed are the best for jelly-making, providing such fruits are rich in pectins and in fruit-acids. Some wild fruits are especially valuable; for example, wild plums, crabapples, grapes and elder berries.

EXTRACTIONS OF JUICES FROM FRUITS

It is an interesting fact that pectin is found only in small quantities, if at all, in the juice from a raw[12] fruit, though the fruit

8. Potatoes from the Housekeeper's Standpoint, Pt. III, Dept. of Home Ec., Colo. State Ag. Col.

9. Potatoes from the Housekeeper's Standpoint, Pt. III, Dept. of Home Ec., Colo. State Ag. Col.

10. Potatoes from the Housekeeper's Standpoint, Pt. III, Dept. of Home Ec., Colo. State Ag. Col.

11. Chodnew, Annalen der Chemie, 48, p. 56, (1843).

12. Jour. of Ind. and Eng. Chem II, p: 460, (1910).

itself may have pectin in abundance. However, such a fruit when cooked yields a juice rich in pectin. Hence, it follows that the best way to extract a juice for a jelly is to cook it out of its fruit. True, the juice of raw currants is fairly rich in pectin, but this is rather an exception to the general rule; but even in this case, only a fraction of the total pectin present in the fruit is found in the juice of the raw fruit.

Washing Fruit

Any fruit that is going to be used for jellies should be thoroughly washed and drained. Some housekeepers object to washing such fruits, saying that the resulting juices are too thin (watery) to "jell" properly. Likewise they claim that fruits for jellies should not be gathered while the dew is on them, or just after a rain. However, such housekeepers will find that proportioning the sugar used according to the pectin in the juice rather than to the water of the juice, will obviate their difficulties. This is one of the fundamental principles of making fruit-jellies, and will be discussed under the topic "Sugar in Jelly-Making."

Juiciness of Fruits

Different kinds of fruit vary much in natural juiciness; for example, fruits like currants, raspberries, blackberries, grapes, are very juicy, while apples, crabapples, quinces, are far less so. In extracting fruit-juices these two classes of fruits—the very juicy and the less juicy—should be treated differently. Hence, we shall consider the two classes separately:

a. Extracting Juices from Very Juicy Fruits. Extraction I.—Transfer the clean fruit to an enameled kettle (not one of metal—as iron, tin, zinc, etc.), add just enough cold water to keep the fruit from burning—possibly one cup to four or five quarts of fruit; heat the fruit gradually, and allow it to cook slowly over a low fire. While it is cooking, stir it very frequently with a wooden or silver spoon to prevent burning. When the simmering-point is reached, mash the fruit thoroughly with a well soaked wooden masher, and then, while stirring constantly, allow the mass to simmer five or ten minutes longer. Provide a double square of clean, heavy cheese-cloth, or a single square of unbleached muslin, large enough to hold the fruit. Scald the cloth, wring it as dry as possible, put it over a large earthen bowl (or some other non-metallic receptacle) and transfer the cooked fruit to it. Tie the diagonal corners of the cloth together, and suspend it so that the juice may drain into the bowl. The writer has sometimes found that a strong bird-cage hook put up in some convenient place in the kitchen or pantry, serves well to support the draining mass of fruit. Of course, if the housekeeper prefers she may use a jelly-bag instead of a square of cloth for draining the juice through. In any case do not squeeze the juice out, but let it drain. We call this first drained-out juice, Extraction I. When it is obtained from a very juicy fruit, Extraction I is very nearly undiluted juice, very little water having been added for the cooking process; such a fruit-juice consists of the

natural water of the fruit containing in solution most of its fruit acids, its natural sugars, its fruit flavoring materials, and much of its pectin. Be sure to test Extraction I for pectin, and save the result to compare with succeeding juice extractions.

Extraction II.—When Extraction I has ceased to drip, return the drained-out pulp to the jelly-kettle. This pulp is yet more or less rich in pectin which can be cooked out. Add to it enough cold water to cover, and stir till the mass is homogeneous. If it is not now sufficiently thin to be cooked up again with little danger of burning, continue stirring and adding more cold water till the right consistency is reached. Again place the kettle over a low fire and while stirring very frequently, as at first, let the mass come gradually to the simmering-point. Allow it to simmer for some time but be careful not to let it burn; the longer it simmers the more pectin, within certain limits, will be extracted. Finally, transfer the re-cooked-out pulp to the freshly scalded jelly-cloth or jelly-bag, and allow it to drain as before. We call this second lot of juice, Extraction II. Compare its taste with that of Extraction I. Test it for pectin also, and compare the result with the amount of pectin you found in Extraction I. You will find Extraction II weaker in taste than Extraction I, but its comparative richness in pectin may vary considerably: this may be less than in Extraction I, it may be quite as much, or it may be even more—all depends upon the nature of the fruit itself, and upon the comparative lengths of the first and second cooking periods. The writer has frequently found Extraction II quite as rich in pectin as Extraction I, and sometimes even richer.

Other Extractions.—This process of extracting pectin from the fruit-pulp may be continued and enough pectin found even in Extraction V[13] to make a good jelly, though generally the pulp is sufficiently exhausted with Extraction III. In case the housekeeper prefers to make "fruit-butter" of the pulp remaining after Extraction I is removed, she may omit further juice extractions.

b. **Extracting Juices from Less Juicy Fruits.**—If the fruit whose juice is to be extracted belongs to the less juicy sort, like apples, crabapples or quinces, then after washing, cut each fruit into quarters, remove the stem, cut out the bud-end but do not peel or core; look out for worms and cut out any bad spots; slice the quarters fine, or put them through a food-grinder, transfer the fruit so prepared to the jelly-kettle, add sufficient cold water to cover, bring it slowly to the simmering-point, then proceed exactly as with very juicy fruits, making as many juice extractions as the pectin test indicates will be profitable.

MANIPULATION OF JUICE EXTRACTIONS

With due regard for the principles of jelly-making, it is quite possible to make jelly from each juice extraction handled by itself, but it is usually not economy to do so. Hence, if Extractions II and III prove to be very rich in pectin, time will be saved if they

13. Jour. of Ind. and Eng. Chem. I, p. 333, (1909).

are mixed directly with Extraction I. Thus, the housekeeper secures at once a juice homogeneous in pectin content, in acid content, and in fruit flavor. If, however, Extractions II and III are not very rich in pectin, it is better to mix these two together first, then boil down their mixture till the resulting juice is tolerably rich in pectin, before mixing with Extraction I.

Grape-Jelly

It is sometimes desirable to bottle Extraction I to be used later simply as a beverage; in this case Extraction I should not be cooked out according to the method given, but should be extracted by cooking the well-mashed fruit in a double-boiler, then draining the juice out as already described. The fruit-pulp remaining should be utilized for juice Extractions II and III according to the method previously given, and the mixture of these two extractions subsequently concentrated to use for jelly. This plan is recommended particularly in the case of grapes, since by this means, the troublesome cream-of-tartar crystals, so likely to appear in grape jelly, are avoided entirely; the cream-of-tartar simply remains in solution in Extraction I, which has been bottled for grape juice, while Extractions II and III when properly concentrated will be sufficiently rich in pectin and plant acids to yield a delicious jelly.

THE JELLY-TEST

Any housekeeper is likely to have a jelly-test which she is in the habit of using. If she thereby gets good results there is no reason for making a change in her practice. However, for reasons given below it seems well to describe the one which has proved most satisfactory in the researches of the writer. It is a test probably used by many. It "is that point at which the boiling mass 'jells,' sheets off, or breaks off as a portion of it is allowed to drop from the stirring spoon. This is a quick test, and hence much better than the time-honored one of taking out a portion of the hot jelly, and allowing it to cool to see if it 'jells,' for while this cooling process is going on outside the sauce-pan, the jelly is continuing to cook inside the sauce-pan. Time is too precious at this point to wait for any cooling of samples; when the jelly is just right to be taken off the fire, no time should be lost in removing it[14]."

THE TIME FACTOR IN JELLY-MAKING

The time necessary for the jelly-making process itself, varies from a few minutes to a half hour or more depending primarily upon the richness of the juice. The altitude also affects the time factor. If very little water has been added in cooking the juice out of the fruit, and the juice is rich in pectin and quite acidic—as in the first extraction of currant juice—then there is little water to be boiled off, so the time necessary for the jelly-making process will be comparatively short. If, however, the juice is not rich, but is thin and watery, then time, more or less will be needed to boil off

14. Principles of Jelly-Making, First Edition, p. 6, (1911).

the excess of water. And in any case, the higher the altitude the longer the time necessary for such concentration.

Skimming Jelly

Throughout the jelly-making process the boiling mass should be kept carefully skimmed; the more thorough this skimming before the addition of sugar, the less the waste of sugar in the subsequent skimmings, and this is an economy which should be considered. The observing housekeeper will quickly discover that the addition of sugar to boiling fruit-juice always helps to clarify the latter.

When To Add Sugar

In deciding whether to add the sugar at the beginning of the jelly-making process or later, it is well to keep the above facts in mind. Also it should be remembered that the longer juice and sugar are boiled together the darker the jelly produced. With some otherwise rather colorless jellies, this darkening may be desirable, but with others it is quite undesirable. A long series of very careful experiments carried out by the writer some years ago led to the following conclusions: The sugar should be sufficiently long in contact with the hot acidic fruit juice, to insure its inversion*, for otherwise large sugar crystals may form later in the jelly. Such inversion will be secured if the sugar is added to the well-skimmed boiling fruit-juice about ten minutes before the conclusion of the jelly-making process. The sugar should be added hot (not scorched!) to avoid cooling down the juice, and the boiling mass should be gently but constantly stirred thereafter to prevent burning. Rather constant stirring before adding the sugar is needed for the same reason, but it is especially necessary afterwards since a fruit-juice sugar solution burns very easily. Burning the jelly while boiling it will irreparably injure its flavor, as well as interfere with its "jelling" properly. In any case when once the sugar is added, the jelly-making process should be pushed through rapidly. No simmering for hours should be allowed, since it is possible to destroy the pectin itself by hours of heating in acid solution.

SUGAR IN JELLY-MAKING

Sugar makes or mars a fruit-jelly, depending upon whether or not it is correctly proportioned to the pectin present in the acidic fruit-juice. The correct proportion of sugar to pectin means success, an under-proportion means a tough jelly, an over-proportion means a jelly that fails to "jell."

Jelly Without Sugar

It is quite possible to produce a product which is jelly-like by simply boiling down fruit-juice. This product, however, does not bear much resemblance to the ideal fruit-jelly. It is merely a con-

*Inversion is a term referring to the change of ordinary sugar (cane-sugar or beet-sugar) into the two simpler sugars: glucose and levulose. This mixture of glucose and levulose (invert sugar) does not crystallize as ordinary sugar does. It is due to the formation of invert sugar that the fondant of well-made candies is so deliciously soft and creamy. Honey is nature's own mixture of glucose and levulose.

centrated fruit-juice, and may vary from a thick viscous syrup to a semi-solid mass more or less tough, with a strong fruity taste. But if with a pectin-bearing, acidic fruit-juice, sugar is combined during the boiling process, a desirable jelly may be produced.

Acids and Sugar Precipitate Pectin

Braconnot, who discovered the alcohol test for pectin—that is, that alcohol would precipitate pectin—found that acids[15] also are precipitants of pectin, and that sugar is likewise. Our foremothers had discovered long before that sugar and acid together are a yet better precipitant of pectin than either one of them alone—since precipitating pectin by means of sugar and acid (the acid of the fruit-juice) was their method of making jellies—just as it is ours today. Jelly-making really is "so controlling conditions by means of acid and sugar and boiling [concentration] as to cause the pectin to be precipitated in a continuous mass throughout the volume allotted to it[16]."

Rule-o'-thumb Jellies

However, our grandmothers' rule-o'-thumb jelly receipt—"A measure of sugar to a measure of juice, and boil till it 'jells'"—did not always produce a jelly that grandmother was proud of. Often the jelly was just right, but sometimes it was tough, and sometimes it failed to "jell." When it was tough, if she dissolved it in hot water, added more sugar, and boiled again she got a better jelly; but when the jelly failed to "jell," such a procedure only made matters worse—the remedy in this case was more juice, rather than more sugar.

Jelly Experiments

Let us try to understand the "why" in both cases, i. e. the principle underlying the use of sugar in jelly-making. So let us take a cup of a good jelly-making fruit-juice and a cup of sugar, then concentrate the solution till the jelly-test is observed, skimming carefully, of course, during the boiling. If the juice used was rich in pectin and fruit acid, we shall probably find, on cooling the product, that we have a desirable jelly. In other words, with a good jelly-making fruit juice, our grandmothers' rule-o'-thumb jelly receipt works.

a. **With Increasing Proportions of Sugar.**—Now let us see what the result will be if we use a larger proportion of sugar with the same amount of fruit juice. So, to another cup of the same fruit-juice, let us add 1¼ cups of sugar, and concentrate as before till the jelly-test is observed. On cooling, we may find that we have a more desirable jelly, possibly a less desirable one; all depends on the richness of the juice in pectin and fruit acid. If the acid fruit-juice is rich enough in pectin to utilize the larger amount of sugar, the second product will be more desirable than the first; but if not rich enough the resulting jelly will be less desirable.

15. Braconnot Annales de Chimie et de Physique, (2) 28, p. 173 (1825).

16. Jour. of Ind. and Eng. Chem. I, p. 340, (1909).

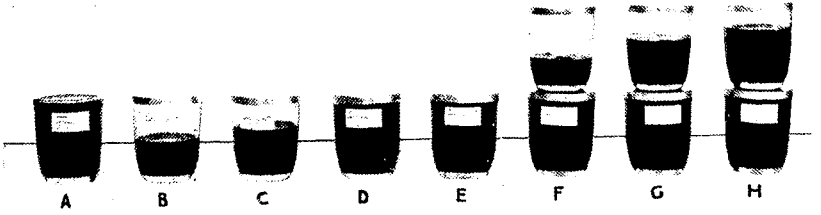

Fig. I. Currant jellies showing the effect on volume of a constantly increasing proportion of sugar to a definite volume of fruit-juice.
A—Juice, amount (1 cup) used for each jelly.
B—Jelly from ¼ cup of sugar to 1 cup of juice (¼:1)
C—Jelly from ½ cup of sugar to 1 cup of juice (½:1).
D—Jelly from ¾ cup of sugar to 1 cup of juice (¾:1).
E—Jelly from 1 cup of sugar to 1 cup of juice (1:1).
F—Jelly from 1¼ cups of sugar to 1 cup of juice (1¼:1)
G—Jelly from 1½ cups of sugar to 1 cup of juice (1½:1).
H—Jelly from 1¾ cups of sugar to 1 cup of juice (1¾:1).

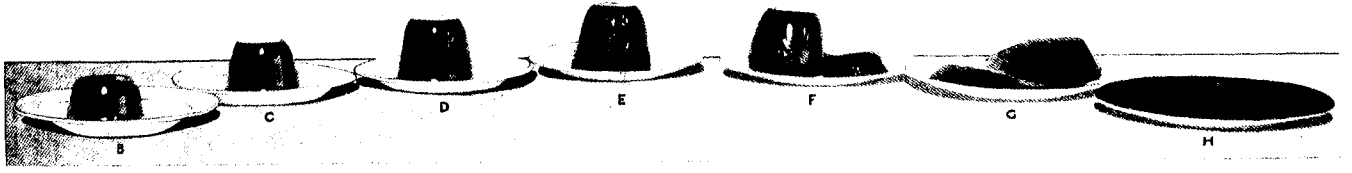

Fig. II. Currant jellies shown in Fig. I, but removed from their molds.

In any case, the second product will be softer than the first, but its volume will be greater. Let us continue these experimental jellies, and to two successive cups of the same juice let us add a further **increasing** proportion of sugar—1½ cups, 1¾ cups, and boil each till the jelly-test is observed; what are the qualities of the series of four jellies so far produced? Each succeeding jelly is softer than the preceding and its volume is greater; the last is scarcely more than a syrup—its pectin is precipitated in lumps; as the proportion of sugar has increased the softer the quality of the jelly produced.

b. With Decreasing Proportions of Sugar.—Finally, let us complete this series of jellies by **decreasing** the proportions of sugar used. This time let us boil three successive cups of juice each with a decreasing proportion of sugar—¾ of a cup, ½, and ¼—till the jelly-test is observed. When we compare these last three products with the first jelly (1 cup of juice with 1 cup of sugar) we find that with decreasing proportions of sugar, the texture of each succeeding jelly is tougher than the preceding and its volume is less.

c. Relation of Sugar to Volume of Jelly Produced.—In Fig. I is shown such a series of seven jellies, each made from one cup of currant juice, the volume, or amount, of which is shown in A. Jelly B, the first of the series, is the product from ¼ cup of sugar to one cup of juice (¼:1); jelly C, ½ cup of sugar to one cup of juice, and so on through the series, the proportion of sugar being increased by ¼ cup in each succeeding jelly, while the volume of juice (1 cup) is kept constant. Note that with increasing proportion of sugar to juice the volume of jelly has constantly increased: Jelly D (¾:1) nearly fills its glass, jelly E (1:1) quite, while jellies F, G, and H (1¼:1, 1½:1, 1¾:1) each require two glasses, and each succeeding second glass is more nearly full.

d. Relation of Sugar to Texture of Jelly.—That as the volume of these jellies increases, the texture grows more and more soft, is shown graphically in Fig. II, which pictures the jellies in Fig. I removed from their molds. Note that they stand alone through Jelly F (1:1¼); the continuously softer texture is more clearly shown in the next two jellies, G and H; the latter falls all over the plate. Of the five jellies which stand alone (B, C, D, E and F) jelly B (¼:1) is very tough in texture; jelly C (½:1) slightly less so, jelly D (¾:1) still less tough; jelly E (1:1) is sufficiently tender to be considered acceptable, but jelly F (1¼:1) is tender enough to be ideal; jellies G (1½:1) and H (1¾:1) are too soft for consideration. In other words, with increasing proportion of sugar, the toughness of these jellies decreases. Of this whole series of seven jellies, E (1:1) is good, but F, (1¼:1) in every respect—its standing power, its quivering power, its retention of angles when cut, its cleavage faces when broken, its tender texture, and its delicious taste—in all these, it measures up to the ideal jelly.

e. Conclusions.—Evidently, then, in the case of the currant juice used in these jellies, the best proportion of sugar to juice was

1¼:1. In other words, this currant juice was sufficiently rich in pectin, and its natural acid sufficiently nicely adjusted to utilize one and one-fourth measures of sugar to one measure of juice—one-fourth more sugar than our grandmothers' receipt called for. However it should not be inferred that all currant juice is always able to utilize this large proportion of sugar; quite often the best proportion is 1:1; hence, the desirability of making one or two "trial" glasses of any jelly before making up the whole quantity of juice.

Making Over Jellies

Now, can anything be done to better the undesirable jellies of this series?—can they be "made over?" Since jelly F (1¼:1) seems to have the best proportion of sugar to the pectin in the juice, then jellies B, C, D and E must have too little sugar, while jellies G and H must have too much. Omitting jelly E, since its texture was acceptable, let us increase the proportion of sugar in jellies B, C and D, till the amount of sugar in each shall correspond to that in jelly F (1¼:1). We can do this best by dissolving these jellies each in a cup of hot water, then adding to jelly B one cup of sugar, to jelly C three-fourths cup of sugar, to jelly D, one-half cup of sugar, and finally concentrating each solution till the jelly test is again observed. What are the results? (Note: In making over tough jellies great care must be exercised to get them entirely into solution, before adding the extra sugar.)

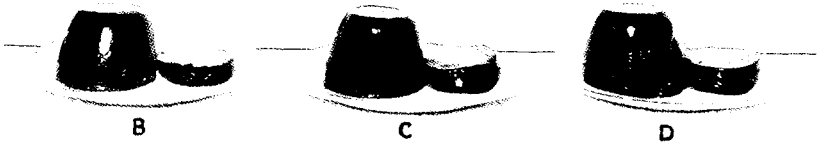

Fig. III. Jellies B, C and D (of Figs. I and II) made over.

Fig. III shows jellies B, C and D thus made over. Each jelly has lost its toughness, each is now of good texture, and each is clear, though its color is deeper than that of jelly F. In each the sugar is now correctly proportioned to the pectin in the acidic juice, (1¼:1). The deeper color is due to the extra boiling these jellies have undergone. Note that the volume of jelly produced is now identical in the three classes: 1¼ cups,—**equivalent in each case to the volume of sugar used.**

Having bettered the tough jellies, B, C and D, by increasing the proportion of sugar in each, how can we improve the soft jellies G and H, that evidently have too much sugar—that is, more sugar than their pectin can take care of? Obviously the remedy in these cases is to add more pectin. This can be done by adding more juice; that is, by adding to each the amount needed to make its proportion of sugar to juice (pectin) equivalent to the proportion in jelly F (1¼:1). Hence, let us add ¼ cup, and ½ cup of juice to jellies G and H respectively, then let us concentrate each resulting solution till the jelly test is again observed.

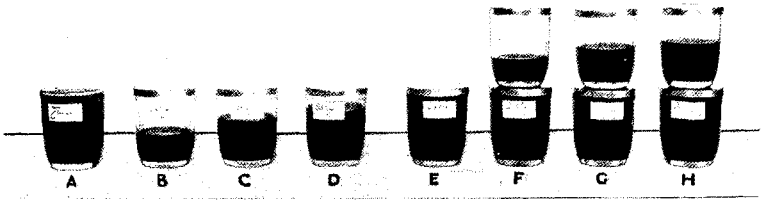

Fig. V. Apple Jellies.
A—Juice, amount—1 cup—used for each jelly.
B—Jelly from ¼ cup of sugar to 1 cup of juice (¼:1).
C—Jelly from ½ cup of sugar to 1 cup of juice (½:1).
D—Jelly from ¾ cup of sugar to 1 cup of juice (¾:1).
E—Jelly from 1 cup of sugar to 1 cup of juice (1:1).
F—Jelly from 1¼ cups of sugar to 1 cup of juice (1¼:1).
G—Jelly from 1½ cups of sugar to 1 cup of juice (1½:1).
H—Jelly from 1¾ cups of sugar to 1 cup of juice (1¾:1).

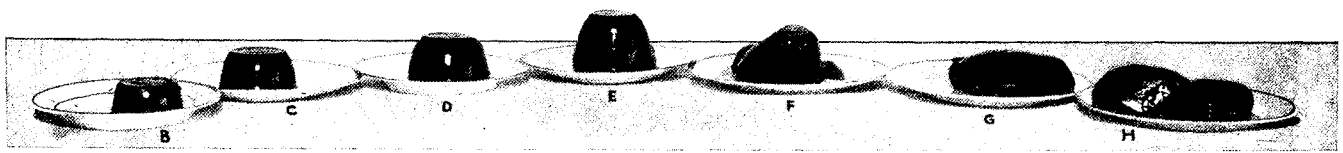

Fig. VI. Apple jellies shown in Fig. V removed from their molds.

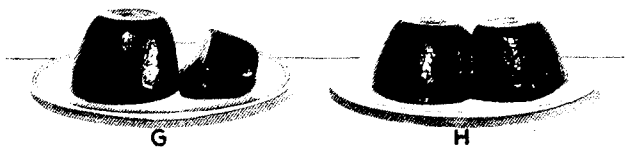

Fig. IV. Jellies G and H (of Figs. I and II) made over.

Fig. IV shows the results of this treatment on jellies G and H. Each one now stands alone; and, in quality, texture and taste, compares favorably with jelly F. Sugar and pectin in each are now correctly proportioned (1¼:1). Note that the volume of jelly produced is less in G (1½ cups) than in H (1¾ cups); this is just what we should expect, since the amount of sugar already present in jellies G and H, conditioned the amount of juice to be added—sufficient to make the proportion of sugar to juice in each 1¼:1. It is an interesting fact that **in fruit-jellies the volume produced always corresponds to the volume of sugar used.**

Apple-Jelly Experiments

In Fig. V is shown a series of eight apple jellies, the making of which corresponds exactly to the eight currant jellies shown in Fig. 1. Fig. VI shows these same apple jellies removed from their molds. From the textures thus disclosed it would seem that jelly E (1:1) was the best of the series. However, although jelly E had a fine texture, yet it was rather too soft, and decidedly too sweet to be considered first class; jelly D (¾:1) surpassed it in both these particulars; hence, it was considered the best of the lot. In other words, the pectin in one cup of the acidic apple juice used was best satisfied by ¾ cup of sugar instead of by 1¼ cups of sugar as in the case of the currant juice. A moment's thought reveals one reason at least why this is true: To cook the juice out of apples, it is necessary to add a considerable quantity of water to the fruit; this added water dilutes the apple juice, and this dilution dimishes the proportion of pectin present in the cooked-out juice. Hence, to make desirable jelly from such a diluted fruit juice, it is necessary to diminish the proportion of sugar to juice, or else first to concentrate the juice sufficiently to drive off the added water before proportioning the sugar to be used. When a fruit-juice is thus concentrated, its proportion of pectin is correspondingly increased. In any case the alcohol test for pectin tells the story.

Sugar, Proportioned to Pectin

The woman who becomes accustomed to the alcohol test for pectin, can usually tell what proportion of sugar to use with any fruit-juice she may be working with. If in doubt, it is a good plan to make one or more trial glasses of jelly, and then proportion the sugar to the remaining juice according to the results obtained. Sugar should be proportioned to a juice according to its richness in pectin, not to its total volume. In any case, if a jelly that will stand alone is desired it is better to err on the side of too little

sugar rather than too much. If a softer and sweeter jelly—one especially for jelly-cake—is desired, then a larger proportion of sugar may be used. **Remember, the less the proportion of sugar to pectin the tougher the jelly; the greater the proportion of sugar the softer the jelly.** If the jelly is too soft even for jelly-cake, the error can be rectified by adding more juice and concentrating till the jelly test is again observed. If too stiff, by dissolving the jelly in hot water, adding more sugar and re-concentrating.

ACIDS IN JELLY-MAKING

The importance of acids in good jelly-making has been repeatedly emphasized. The three most common fruit acids—citric, malic and tartaric—have already been briefly described. Of these three acids, the last, tartaric,[17] is the most efficient in jelly-making, malic[18] is second in efficiency, and citric[19] is third. In the language of the chemist, this efficiency of an acid depends directly upon its chemical activity. Within certain limits the more active the acid of a rich pectin-bearing fruit-juice, the more decided its jelly-making possibilities. However, a comparatively large proportion of a very active acid in such a fruit-juice sometimes leads to syneresis,[20] or weeping, of the jelly—that is, a slight separation of water or juice from the jelly. As every housekeeper knows from experience, different fruits vary much in acidity. Currants and grapes are particularly rich in tartaric acid, and the active acidity of this acid combined with the richness of these fruits in pectin, accounts for their valuable jelly-making properties. Crabapples and sour apples are rich in malic acid and also in pectin; hence the comparative ease with which jellies can be made from these fruits. The juices of lemons and oranges are very rich in citric acid, but they carry no pectin; however, the white inner skin of these fruits is full of pectin, so by properly extracting this, it is possible to make genuine lemon and orange jellies, in spite of the relative inactivity of citric acid; these jellies will be considered in more detail further on.

Acidifying Fruit-Juices

When a fruit-juice lacks in acidity but is rich in pectin, one of the fruit-acids—preferably tartaric—may be dissolved in it and a jelly of good texture subsequently made.[21] However, any such addition of a foreign acid to a fruit-juice, invariably changes the original flavor of the juice and often to its detriment. To give any definite rule for the amount of acid to add to such a fruit-juice is impossible since juices vary so much in acidity. Try this method: To each quart of juice add one-half level teaspoonful of powdered tartaric acid, and stir till the acid is entirely dissolved; then taste; for jelly-making the juice should be about as tart as that of good sour apples;

17. Jour. of Ind. and Eng. Chem. I, p. 335 (1909).

18, 19. Tarr, Fruit Jellies, The Rôle of Acids, p. 3, Exp. Station, Univ. of Delaware.

20. Tarr, Fruit Jellies, The Rôle of Acids, p. 3, Exp. Station, Univ. of Delaware.

21. Jour. of Ind. and Eng. Chem., I, p. 335, (1909).

if this amount of acid does not make the juice tart enough continue this addition (and subsequent solution) of tartaric acid powder but in small amounts, till the desired tartness is reached; then proportion the sugar to be used according to the richness of the juice in pectin and proceed with the jelly-making process as with any other juice.

Effect On Jellies

In the case of the more delicate fruits, like peach and pear, both of which are rich in pectin but lacking in acidity, such addition of a foreign acid to the juice invariably impairs the fine flavor of the fruits, though it usually leads to jellies of good texture. Sweet apple and quince juices on the contrary, when so acidified, yield jellies improved not only in texture but also in taste. Needless to say, both sweet apple and quince juices are rich in pectin—the latter phenomenally so, though deficient in acid.

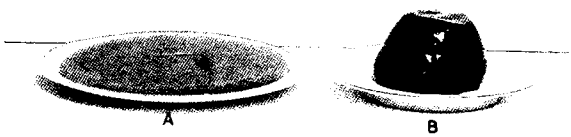

Fig. VII. Quince Jellies (1:1).
A—Jelly made from unacidified juice.
B—Jelly made from acidified juice.

Quince Jelly

The necessity of acid in jelly-making as well as the effect of adding a foreign acid to a non-acidic fruit-juice is graphically shown in Fig. VII. These two jellies were made from quince juice and the proportion of sugar to juice in each was 1:1. For jelly A the natural juice, unacidified, was used, but for jelly B the juice was acidified in the proportion of one teaspoonful of tartaric acid powder to a quart of juice. Jelly A was hopeless as a jelly—though of course it could be made over—but jelly B was of excellent texture and taste, though its natural quince flavor was much modified. Our grandmothers experimented till they learned they could get around this deficiency of acid in quince juice by mixing sour apple with it and thus making a compound jelly—the sour apple juice, in this case, supplying especially the needed acid.

COMPOUND JELLIES

Indeed, the use of apple juice as a basis for various fruit-jellies is a very old household practice. By the ancient "trial and error" method, our foremothers long ago discovered that the "jelling" properties of certain fruit-juices were much improved when combined with apple. Hence, the origin of "compound" jellies. Today we know that the value of the apple juice, in such jellies, lay in its wealth of pectin and acid, one of which at least was needed by the weaker or non-jelling juice. As a means of adding variety to

the diet, compound jellies have something to commend them. Certain fruits rich in flavor or color but deficient in pectin (as chokecherry), or in acid (as pear), or in both (as cactus) sometimes lend their good qualities very well to such combination jellies. Desirable jelly variations perhaps, but mixtures certainly, and so our grandmothers considered and labeled them: Apple and Quince, Apple and Pear, and so on.

Commercial Jellies

Manufacturers in the process of absorbing the tasks of the household unto themselves, quickly saw the possibilities of compound jellies. Of course, if honestly labeled, there is no reason why such jellies should not be put upon the market. Commercial jellies may satisfy some housekeepers. It is possible for apple jelly to be very delicious, but any housekeeper resents buying what she supposes to be currant jelly for example only to find later that it is "Apple Jelly with CURRANT Flavor"—currant being writ very large on the label.

Windfall Apples

The thrifty housekeeper knows that it is unnecessary to use first quality apples for jelly-making. Windfall apples may be used advantageously for apple jellies, or for compound jellies. When properly prepared for juice extraction—that is, when properly cleaned and all bad spots and worms removed—windfall apples are valuable sources of the essential constituents of jellies; particularly valuable since fruits not wholly ripe as already pointed out, are richer in pectin than when fully ripened. Such apples may often be the source of the housekeeper's whole stock of apple jellies and of compound jellies.

Commercial Pectin

Commercial pectins have made their appearance on the market since the publication of the results of the author's researches (1909-11). Such commercial pectins are usually merely thick concentrates of fruit-pectin extractions—apples most frequently—certainly a very good source of pectin as we have learned, only let us hope that the manufacturer is as careful to remove all contaminated portions as the housekeeper would be! Of course the use of such commercial pectins is quite legitimate if the housekeeper cares for them. But she should remember that combining them with other fruit-juices leads merely to a compound jelly.** Needless to point out, the thrifty housewife can easily concentrate apple extractions and so produce her own apple pectin for her compound jellies if she desires. Extractions II and III are best for this purpose since their taste of apple is less pronounced.

** The United States Department of Agriculture, Circular 136, defines a fruit jelly as follows: Jelly is the sound, semi-solid gelatinous product made by boiling clean, sound, properly matured and prepared fresh fruit with water, concentrating the expressed and strained juice, to which sugar (sucrose) is added, and conforms in name to the fruit used in its preparation.

GENUINE ORANGE AND LEMON JELLIES

In the course of the author's researches in 1908-11, the thick, white inner skins of oranges and lemons were found to be rich sources of very pure pectin when properly extracted. To extract the pectin, use a sharp knife and very carefully peel off every trace of the thin outer yellow skin of the fruit, remove the white inner skin thus exposed, grind it fine in a food-grinder, soak it from two to twenty-four hours in sufficient water to cover, then cook it slowly for some hours, replenishing the water as necessary; finally drain off the pectin extraction thus secured through a scalded cloth or jelly-bag. Test a teaspoonful for pectin.

"This Extraction I is particularly rich in pectin. Subsequent extractions all show pectin but continually decreasing in amount. These extractions may be concentrated and mixed with the first extraction if desired. To the whole, enough of the natural juice is added to give a pronounced flavor [acidity], and it is then made into jelly the same as any other juice, due care being taken not to use an excess of sugar. If the thin outer yellow skin of the fruit has been carefully removed, there will be little if any bitter taste to these jellies.

"If desired, the white inner skin of oranges and lemons may be used as a source of pectin to add to other fruits which are more or less deficient in this important substance. For example, some excellent rhubarb jelly was made in the kitchen of this department by adding to the cooked-out rhubarb juice a rich pectin extraction obtained from lemons as indicated.

"For such purposes in general, it is suggested that the white inner skins of oranges and lemons be saved from time to time, cut into fine pieces and dried, then later soaked up and used as desired. Hence, what is usually a waste product, but what has been found to be an abundant source of pectin, may be used by the thrifty housewife in numberless ways to help out in her jelly-making.

"It may be worth while to note in this connection that the thicker skinned the oranges, the greater the yield of pectin that can be obtained from them.

"The white inner skin of grape-fruit is also rich in pectin, but the persistent bitter taste interferes with its use in jellies. However, the housekeeper may find it valuable in marmalades.[22]"

CANNING JUICES FOR FRUIT-JELLIES

Some housekeepers, rather than to put up a quantity of fruit-jellies in season, prefer at that time to can fruit-juices for them, and make up the jellies as needed later. The plan certainly has some practical advantages:

1. Quite a saving in the cost of the necessary sugar may thus be effected, since sugar is more expensive during the fruit season than at any other.

22. Principles of Jelly-Making, First Edition, 1911.

2. The jellies may be made up during the cooler months when it may be less uncomfortable to work over a hot stove, and also when the pressure of other work may be less.

3. The plan means fresh jellies when needed—though if jellies are properly sealed when made and kept cool there is little danger of their not being in prime condition when opened.

Method of Canning Fruit-Juices

Concerning the canning of such juices, a few suggestions are in order:

1. Use no can that leaks. Wash all cans thoroughly, then test each as follows: Pour a cup of water into the can, slip on a perfect rubber, seal as tightly as possible, wipe the whole outside perfectly dry, invert the can and stand it in a dry pan for an hour or less; if the can leaks, an occasional bubble of air will be seen passing up through the water, while **drops of water** will **seep out** around the cover. If a different rubber or the use of two rubbers, does not remedy the leak, discard the can. Such testing of each can seems especially imperative in all cans made since the beginning of the Great War.

2. When ready for the canning process, place the cans and covers in a clean pan, sterilize them thoroughly by pouring boiling water over and into them, and finally filling them up completely with boiling water; let them stand a few minutes.

3. To avoid canning any unnecessary amount of water, concentrate the mixture of Extractions II and III till fairly rich in pectin, add the concentrate to Extraction I, and bring all to a boil. Empty the sterilizing water from the cans, pour the boiling juice into them and seal at once, but without having wiped or even touched the inside of the covers in any way! Invert the sealed cans in a clean dry pan and allow to cool. While cooling, note whether or not tiny bubbles of air pass up through the liquid. If they do, the juice will not keep, and must be re-canned in a perfect container.

4. A supply of cans of various sizes will usually obviate the necessity of filling up any cans with water, as so many housekeepers are in the habit of doing. It is a pernicious habit which can be largely avoided by a little foresight. Can juice, or fruit, or vegetables for future use, **not water!**

5. Before putting away the canned juices be sure each is labelled properly.

SEALING UP FRUIT-JELLIES

The jelly-glasses should be thoroughly sterilized just before using. Place the clean glasses in a pan, pour boiling water over and into each till completely full, and let them stand till the jelly is ready to pour out; then empty the glasses quickly (shake out the water, but do not wipe!) and fill them at once completely with the hot jelly. Put the jellies, in a clean, cool place to harden, but do not cover them. When well set they will be somewhat shrunken. Now fill up the glasses with hot paraffin (not merely melted), and

close with hot, dry jelly-glass covers; keep in a dry, cool place. The paraffin should be **hot** that all germs which may have fallen upon the surface of the jellies may be killed and future trouble with them obviated. Our grandmothers, though unacquainted with germs, killed such germs with alcohol—they fitted a paper wet with alcohol over the hardened jelly, and then pasted clean white paper over the top of each glass. Our present method is much quicker and quite as efficient if the paraffin is hot. Don't forget to label the jellies. Jellies properly sealed and kept in a cool, dry place will keep indefinitely.

THE MAKING OF FRUIT-JELLIES AN ART AND A SCIENCE

Fruit-jelly making, as practiced in the home is an art—an art founded on scientific principles. "The more complete the scientific basis of an art, the more perfect the art.[23]" Were the housewife always a chemist, and had she always the means and time at her disposal to analyze accurately each fruit-juice for pectin, kind of acid and active acidity, it would not be difficult to apportion the required sugar accordingly, and then to concentrate the resulting solution to the precise jellying point. All these processes, thanks to the researches of chemists, the manufacturer of today is able to carry out. Thus has woman's ancient art of jelly-making been developed to an exact science.

FRUIT-JELLIES AS FOODS

The value of fruit-jelly as food is dependent mainly upon its mineral matter[24] and sugar. This mineral matter though small in amount is carried by the fruit acids of the juice, and is of prime importance to the human body in helping to maintain its fluids in a slightly basic or alkaline condition. Sugar is one of our exceedingly important energy[25] foods. Furthermore, the beauty and artistic worth of an ideal fruit-jelly are of no small importance in the diet of both the sick and the well—tempting the one, refreshing the other; such is another function of a delicious fruit-jelly—palatable and transparent, and withal exquisitely colored in Nature's own laboratory.

SCORING FRUIT-JELLIES

In the friendly rivalry of the county fair, and farmers' clubs, there is much demand for scorecards of all sorts. One by the author is appended.

Of course it is quite unnecessary to emphasize the fact that it is altogether impossible to score any jelly justly without removing it from its mold. In no other way can its standing power, it quivering power, its angle-retaining power, its tenderness or toughness, its cleavage be tested. Then too, to score a jelly justly it must be tasted; merely to look at it—to examine it for clearness and beauty of color—is not enough.

23. Century Dictionary, See Art.

24. Potatoes from the Housekeeper's Standpoint, Part III, Department of Home Economics, Colorado State Agricultural College.

25. Potatoes from the Housekeeper's Standpoint, Part III, Department of Home Economics, Colorado State Agricultural College.

THE AUTHOR'S SCORE-CARD[26] FOR FRUIT-JELLIES

		Points	Totals
I.	Choice of fruit for jelly-making	5	5
II.	Color—		
	a. As determined by the fruit	4	
	b. Depth, as influenced—		
	1. By sugar	3	
	2. By boiling	3	10
III.	Clearness (transparent or otherwise)	10	10
IV.	Absence of crystals	5	5
V.	Texture—		
	a. Preservation of shape when removed from mold (not syrupy)	5	
	b. Power of quivering	5	
	c. Can be cut with spoon; angles retain shape, (not gummy nor sticky)	5	
	d. Tenderness vs. toughness	5	
	e. Character of cleavage—		
	1. Not brittle, yet breaks with distinct cleavage	5	
	2. Sparkling faces	5	30
VI.	Taste or palatability—		
	a. Preservation of natural flavor of fruit	25	
	b. As affected by sugar, neither too much nor too little	10	
	c. As affected by boiling (not burned)	5	40
			100

26. Principles of Jelly-Making, Third Edition, (1914).

SUMMARY

I. The essential constituents of fruit-jellies are pectin, fruit-acid, sugar and water.

II. Pectin is the gelatinous substance in fruit-juices which "jells." It is tested for most easily by alcohol (either denatured, or wood).

III. Tartaric, malic and citric acids are the most common fruit-acids. Of the three, tartaric is the most efficient in jelly-making.

IV. For jellies, the fruits best fitted for them by nature—that is, fruits rich in pectin and fruit-acid, and not over-ripe—should be chosen.

V. Juices of raw fruits rarely contain much pectin though the fruit itself may have an abundance of it. Such a fruit when cooked yields a pectin-rich juice. Hence, juices for jellies should be cooked out of the fruit.

VI. Extractions II and III should usually be concentrated more or less before being mixed with Extraction I.

VII. A quick, decisive jelly-test is preferable to one which involves a waste of time.

VIII. Sugar should be proportioned according to the richness of a juice in pectin, rather than to the total volume of the juice; it should also bear a certain relationship to the active acidity of the juice. It should become "inverted" during the jelly-making process.

IX. The time-factor in jelly-making depends upon the amount of water to be evaporated off.

X. Apple-juice as a basis for compound jellies is an old household practice. The accessory use of a commercial pectin in jelly-making leads to a compound jelly.

XI. The white inner skins of oranges and lemons are rich sources of pectin.

XII. It is sometimes advantageous to can fruit-juices for future jelly-making purposes.

XIII. Fruit-jellies properly sealed and kept in a dry cool place will keep indefinitely.

XIV. Fruit jelly-making in the home is an art resting on scientific principles.

XV. The food value of a fruit-jelly depends upon its small content of mineral matter, and upon its sugar content.

XVI. Don't attempt to "score" a fruit-jelly unless you are allowed to remove it from its mold. No other procedure can be honest.