Honey

Elmer F. Glabe

Honey is man's oldest sweetener. Honey is a sweet carbohydrate substance produced only by bees and one species of ant. Bee honey has been and is, an important type of sweetener for food, having been used thus by man for many centuries, indeed thousands of years. Egyptians and early nations of the Near East apparently used honey extensively. Honey has been found in the tombs of the pharaohs and, significantly, in an unusual state of preservation, attesting to its uniqueness. Api-culture is now an important part of the food production work of peoples in most of the temperate climate areas of the world.

Of the 250 million pounds of honey produced annually in the United States, approximately onethird is used in bakeries. White bread, variety breads, sweet rolls, cake, cookies and graham crackers are the chief areas of application in this industry-as shown in Slide No. 1. Coatings and toppings for rolls and buns constitute other uses for honey.

Slide #1
HONEY
USING IN BAKERY PRODUCTS<P>

	RANGE OF USE
Variety Breads	3-7% *
Special Diet Breads	2-3% *
White Breads	3-4% *
Honey Bread	6-7% *
Buns & Sweet Goods	3-5% *
Cookies-Graham Crackers	3-12%
Toppings, Glazes	5-15%

* Based on Flour Weight

Honey is useful to the baker for two reasons. It is a source of specific flavor for bread and similar yeast-raised products. it is also a means for in creasing the shelf life properties of the bakery foods. The increase in shelf life of bakery foods containing honey is due to the presence in honey of large amounts of levulose sugar. This monosac charide has the ability to combine with water with which it has a strong affinity. Thus, when honey is introduced into bakery products, this sugar-moisture combination exerts a very significant effect on the texture of bakery foods-resulting in better texture and longer shelf life for most yeast raised products.

Fat-based softener compounds have greater texture-softening effects than honey. However, where fat-based softener compounds cannot be used or may not be desirable for use, the shelf life-increasing properties of honey make it an important ingredient for the baker. Combinations of fat-based softeners and honey have pronounced texture effects.

With this importance to the baker in mind, let us examine the origin, properties and characteristics of honey as they affect its usefulness to the baker and how they can provide guidelines in purchase, storage and use of honey.

Honey is manufactured by bees from the nectar of flowers. The bees' capacity for collecting this substance is prodigious. The expression "busy as a bee" may well arise from the fact that it has been estimated that to make one pound of honey, bees must fly more than 50,000 miles in transporting nectar from the flowers to the hive!

Nectar is a substance with a complex chemical nature. Besides water, mineral materials, organic acids and a small amount of protein, it contains large amounts of dextrose. The latter compound is converted by an enzymatic process carried out by bees to its chemical isomer, levulose-which is the chief component of honey. Nectar also contains complex aromatic chemical compounds which are carried over into the honey, where they act as powerful flavoring agents.

Honey comes from virtually every geographical area of the United States and parts of Canada. Very considerable quantities of honey used by the United States baking industry come from Yucatan in Mexico, several South American countries and from as far away as Australia. These widely-scattered sources of origin, with hundreds of different nectar sources, give rise to the diversity of flavor and chemical composition of honeys. Therefore, selection of honey for use in bakery products, where taste and texture quality standards must be met, involves the following basic facts.

Liquid honey contains, on the average, 80 percent solids and 20 percent water. This water must be taken into account when calculating dough absorption levels.

In general, honey is classified into several major categories, where color and flavor are the chief differentiating features. These categories are shown in Slide No. 2. Darker color virtually always parallels stronger flavor. The color of liquid honey is determined with an optometric instrument giving numerical values. These values are known as the Pfund Rating, being named apparently for the originator of the test. The data in Slide No. 2 show that Pfund Ratings increase as the depth-of color increases.

Slide #2
CATEGORIES OF HONEY

TYPE AND COLOR	PFUND VALUE
Water White	4-8
Extra White	9-17
White	18-34
Extra Light Amber	35-50
Light Amber	51-85
Amber	86-114
Dark Amber	Over 115

Along with color and flavor changes varying due to source, honey does vary in chemical composition. Slide No. 3 shows the important components of average, medium amber honey. Water and levulose and dextrose levels strongly affect the viscosity and storage properties of honey. Crystallization of honey during storage occurs when the normal average moisture content of 18 to 20 percent is reduced by as little as one to two percent. However, the dextrose content is an even more important factor. A slight increase in this crystallizable monosaccharide is largely responsible for the well-known "sugared honey" seen by every user specially if the honey has a low moisture content and is subjected to low storage temperatures.

Slide #3
COMPOSITION OF HONEY
Average of 490 Samples

Moisture	17.2%
Total Solids	79.79
Levulose	38.19
Dextrose	31.28
Sucrose	1.31
Maltose	7.31
Higher Sugars	1.50
Nitrogen	.04
Mineral Material	.16
Undetermined Materials	3.01
TOTAL	100.00%

Slide No. 4 shows the range in the levels of levulose, dextrose and moisture content in honey.

Slide #4

VARIATION IN CHIEF COMPONENTS OF HONEY
AVERAGE OF 490 SAMPLES

	RANGE IN PERCENT
Moisture	13-23
Levulose	27-44
Dextrose	22-41
Sucrose	.25-8
Maltose	3-16
pH	3.42-6.10

Honey having an average moisture content of 18 to 20 percent and a dextrose content of not more than 31 percent has virtually limitless storage properties if storage is carried out at approximately room temperature and the containers are not opened so that evaporation of water can take place. Liquid honey reaches the bakeries in 55-gallon steel drums or five-gallon cans, weighing 650 and 60 pounds, respectively.

The high sugar content of liquid honey makes it a very poor substrate for bacterial growth. Molds also do not grow on honey having less than 20 percent moisture. Furthermore, such honey need not be stored at closely-controlled temperatures, in contrast to some sugar syrups from other sources.

Honey is readily fermented by yeast. Some fermentation by wild yeasts occurs during storage of honey of high moisture content, usually due to deliberate adulteration of the honey with water.

For bakeries using honey, the requirements of constant composition and flavor can be met by purchasing from suppliers having the ability to collect honey repeatedly from the same points of origin. More important, is the ability to blend honeys from various sources, on a large volume basis, to maintain a constant flavor level and type.

Comb honey, as it comes from the hives, requires processing before the honey is usable in a bakery or by any food processor. The steps in the process are shown in Slide No. 5.

The bees store the honey in wax combs. These combs are built in wood frames provided for the bees by the apiarist. The honey is removed from the combs by centrifuging. At this point the apiarist mixes honey from various hives and maybe from several colonies, introducing the factor of flavor and color variability in the finished honey in some locations.

The honey must next be strained through suitable metal or cloth sieves. The straining step, if not carefully carried out, will not remove bee parts. These can carry over into finished bakery products where they will add to the count of extraneous matter as insect parts if the baked products are so analyzed.

To insure complete removal of extraneous matter, honey is filtered through pressure filters using diatomaceous earth or other suitable filter media. Honey which is offered to the baker directly from some apiarists or small collectors may not be filtered and, therefore, may still contain bee parts as well as wax.

After filtration, blending takes place if required. This is a desirable processing step since it assures a more uniform color and flavor-both of which are important to the baker. The blended honey is then available for use in bakeries or for further processing into dehydrated honey, which in turn reaches- the bakeries in that form.

Honey is a viscous liquid with a strong affinity for metal. This characteristic makes it difficult to pour honey and even more difficult to accurately measure honey by volume. If a container of honey is weighed, transferring the honey from the weighing receptacle is difficult to accomplish without loss. Losses due to the material remaining in the original shipping container are in the area of 10 percent. In view of this characteristic, honey has been made available to the baking industry in several Physically-modified forms which reduce the losses due to handling.

Two forms are plastic in nature, making for some improvement in handling. One, called whipped or churned honey, is made by rapidly beating or whipping low-moisture honey at low temperatures The second form combines honey with very significant portions of invert sugar to make a plastic composition by special mixing procedures. Churned honey and the plastic form combining honey and invert sugar handle much like shortening, thereby offering something in the way of improved handling properties over liquid honey.

Two forms of dehydrated honey products also exist. One makes use of crystalline sucrose as the replacement for the water of honey. This product is very hygroscopic.

Dehydration of honey is a difficult procedure. First, dehydration must be accomplished without loss of the delicate honey flavors. Secondly, the levulose of the honey must be separated from the water fraction with which it has a very high affinity. This affinity is the basic characteristic making honey useful in baking. It must be preserved.

Once separated from the water, the solids of the honey are highly hygroscopic. They very quickly absorb atmospheric moisture and all semblance of a truly dehydrated product disappears. The solution to the problem has come by replacing the water of the honey with a dehydrating and stabilizing substance. This is not a simple blending or mixing procedure. Starch and flour function very well in this respect. The replacement of the water is almost empirical and the resulting dry product is and remains free-flowing on exposure to the atmosphere. Dehydrated honey products afford ease of handling and thereby reduction in losses due to scaling, measuring and transferring, without loss of honey flavor. Storage life of dehydrated honey at normal warehouse temperatures in unopened containers is limitless.

Slide No. 6 shows the added texture-softening effect on white bread of the dehydrated honey product in which the water in the honey has been replaced with starch. The water-holding property of honey in bread appears, therefore, to have been increased when starch is used as the water-replacement-bridge in this dehydrated honey product.

Slide #6
BREAD TEXTURE SOFTNESS
BY COMPRESSIMETER

	DOUGH WATER ADJUSTMENT	BREAD AGE 1-DAY	BREAD AGE 4-DAYS
1. Control - 6% Sugar	Standard	116	41
2. 7.4% Liquid Honey	Decreased by 13%	119	43
3. 7.4% Dehyrated Honey Product	Increased by 3.5%	118	57

Liquid honey contains diastatic and proteolytic enzymes in varying amounts. The latter can cause some difficulty when liquid honey is used in refrigerated dough products. These enzymes can affect loaf volume and structure. A shift to dehydrated honey products in such doughs eliminates the problem, since these enzymes are in activated during the drying process.

In conclusion, honey, a natural sweetener, is an efficient and versatile baking ingredient, popular for its unique flavor enhancement and its ability to improve the texture of many bakery foods. It is available in liquid, plastic and dehydrated forms.

About the Speaker

Elmer F. Glabe, from Chicago, Illinois, received his Degree in chemistry from a midwestern university. He is a food scientist, president of his own research and development laboratory doing work in all branches of the food industry, primarily bakeries. He has had considerable experience in publishing papers and technical literature in the trade press. He is the inventor of many food processes, presently holding more than 40 United States and foreign patents. He is a 35-year member of our Society, a former vice president and program chairman.

Water Pre-Ferments

Daniel M. Stakley

In this brief discussion, we shall examine water pre-ferments and their ability to produce a quality product and a profit.

All normal varieties of bread and rolls prevalent in this country may be produced by the use of this system. While it may be extravagant to claim that this process is applicable in all situations-it is suitable for many I believe it is quite adaptable to English muffins, sweet goods, and other yeast-raised products.

Water pre-ferments can yield very good product uniformity With all other factors, such as fermentation, plant operation and work force, under proper control, you are well on your way.

It is important to recognize, however, that a water pre-ferment will not perform .optimally in situations where the flour is purchased strictly on the basis of price rather than quality In other words, the process demands a consistent and good quality protein for best results.

I have yet to meet a baker who is completely satisfied with the consistency of his flour's protein quality The lack of consistency in protein quality can cause nightmarish problems with this process. I recall how, a few years ago when protein quality was especially poor, we had to struggle through the new learning experience of dealing with poor protein quality Mixing times had to be extended to as much as 23 minutes. This, in turn, produced doughs with inadequate or erratic development that yielded non-uniform products and resulted in numerous consumer complaints. This impressed on us that consistent protein quality is absolutely critical if this process is to produce a quality product.

Product uniformity itself is the result of many influences which include, in a descending order of importance, the following: (1) mechanical equipment and its dependability; (2) system control; (3) work force discipline; (4) effective technical knowledge availability; and (5) ingredient selection.

These and other influences, when properly controlled, create a level of consistency that will enhance any system. Some think of this as uniformity of process control. I maintain that product uniformity is possible only with the above undergirding.

Essentially the same level of such quality attributes as eating properties, shelf life, taste, flavor, grain and texture, and eye appeal, is attainable with this system as with any other process, although this judgment has to be to some degree subjective. It is true that some processes create subtle flavor differences, but it is equally true that all processes are equally capable of producing desirable flavor characteristics.

The production of a consistently high quality product requires that certain elements be present. These include:

1. A good quality protein in the flour
2. Adequate quality controls of fermentation, with emphasis on pH and TTA profiles.
3. Appropriate technical skills on the part of the supervisory staff. This is of greater importance in the case of the water pre-ferment process than in other processes. The reason for this is the system's lesser tolerance to fluctuations in protein quality as no pre-conditioning of the flour takes place. Variations in protein quality are immediately apparent to the trained production man.

The inability of supervision to recognize protein quality variations is, in my opinion, the most serious problem that confronts bakeries that use this process.

The advantages of this process are distinct, and many, once the variables have been brought under control. From the viewpoints of capital investment required for this system as well as its costs of operation, maintenance and sanitation, its superiority over other processes cannot be disputed.

A philosophy that many can relate to may be expressed thusly: quality is our most important product, flour is our most important ingredient, and profits generate the drive.

Let us look at the six process variables that impact on that philosophy.

1. Time
    a. Greater number of doughs from each pre-ferment.
    b. Less time spent on pre-ferment setting.
    c. Water pre-ferments can be held for longer periods than flour pre-ferments.
    d. Less opportunity for human error to occur when setting fewer pre-ferments.

2. Labor

    Normally, no additional man power required for setting pre-ferments.

3. Tolerance

    Degree of tolerance is directly related to flour protein quality

4. Sanitation
    a. Absence of milkstone buildup.
    b. No buildup of lecithins.
    c. Advantages of clean-in-place.
    d. Near absence of sources for insect infestation.
    e. Many fewer sanitation man-hours as compared with other systems.

5. Equipment
    a. Great flexibility of tank configuration, size and numbed
    b. Great refrigeration tolerance as to type and amount.
    c. Good availability of equipment-both new and used.

6. Space Requirements
    a. Minimum floor space needs.
    b. No control of environment required.
    c. Greater options for equipment placement.

In a water pre-ferment the process variables just discussed fit the situation, like a glove fits your hand.

In closing, I want to drive home this point.

The key to the successful use of the water pre-ferment in the production of quality products is without question the consistency and quality of the protein of the flour being used. The reason for this is the lesser tolerance inherent in a water pre-ferment. In the absence of a good flour protein that is essential to improve the tolerance of this process, uniformity and quality become difficult to achieve and product damage will rise.

This method, as any other, has its advantages and disadvantages. If its parameters are respected, it will perform well.

About the Speaker
Dan Stakley lives in Angola, Indiana. He is division vice president for a large multi-plant producer of buns for the fast food industry.

His responsibilities include manufacturing, sales, and all labor negotiations. He has had experience in the startup of

three new bakeries, including one in England, and a total distribution center.

Dan is a graduate of the American Institute of Baking, and he represents the third generation of his family in the baking industry