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COARSE Granulation of Honey

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ALL BEEKEEPERS are familiar with honey granulation and know how to cope with it. They have learned that because honey is a supersaturated solution, the excess sugar will crystallize in the ordinary course of events. Most know how to apply controlled heating to bring it back to the liquid state without flavor or color damage. This appears to be a simple process of redissolving the crystalline sugar in the liquid honey, but it can be a source of much trouble. Use of improper time—temperature combinations (high temperatures or even exposure to moderate temperatures for excessive times) can seriously damage delicate honey flavors. Difficulty can also arise if in the treatment of partly granulated honey the liquid part is removed before it can act as a solvent for the crystallized dextrose. Ordinarily this will not happen, since granulated honey is "melted" in the same container in which it had crystallized. Thus there is plenty of "solvent" in which to dissolve the sugar.

Larger Packer May Have Difficulty

The potential difficulty lies in the different ways used by small and larger packers to liquefy honey. The larger operator uses a hot room and inverts the cans of honey on racks so that as the honey liquefies it flows away and is led out of the room, thus avoiding excessive exposure to heat. In general this is an efficient and successful way to liquefy honey. However, if the liquid part drains away rapidly and leaves much solid in the can, the residue will not dissolve and remains in the solid state. Even though higher temperatures are used, it is practically impossible to liquefy this residue.

Partial Coarse Granulation a Cause

Several years ago a Texas packer had this happen with 40 cans of honey; there were from 10 to 30 pounds of residue in each can. He had noted that the honey had been only partly granulated with heavy, coarse crystals. The probable cause for his difficulty was the coarse-textured granulation, which being much more resistant to dissolving than smaller crystals, did not do so before the liquid part drained away. Such a situation could be expected to arise with previously heated honey, since it is well known that heated honey will re-granulate with large, coarse crystals unless seeded with fine-grained honey.

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Can the Residue be Recovered?

Refilling such partly emptied cans with honey and reheating will not be very useful, since any honey added is almost saturated with dextrose at the higher temperature and cannot dissolve much more. The best material to add is the liquid that had drained away from the residue, since it is probably not saturated with dextrose. Often this cannot be done, since it has mixed with other honey. If water is added instead and the mixture is heated the residue will dissolve, but the resulting solution is of limited use such as for stock feed.

Not a Sign of Adulteration

We have known of three recent cases when the finding of crystalline residual material from honey melting has been regarded by a packer as a possible sign of honey adulteration by the producer. We have analyzed two such materials sent to us. One was in 1956 from Arkansas, and the other was sent from Minnesota in 1958. The results of our analyses are given in the table. We have also seen an analysis by a commercial firm on a similar residue in 1957 from a third state. This analysis was quite close to those given in the table, and they concluded that the sample was an adulterated honey.

Table 1

Composition of Granulated Residue from Honey

	Minnesota %	Arkansas %	Average Honey * %
Moisture	12.5	12.6	16.7
Glucose	64.39	66.01	32.2
Fructose	14.56	18.13	38.8

* See reference 1.

The values in the table fall quite outside the usual composition and approximate that of a crude dextrose hydrate, which of course it is. The analysis reflects the composition of the material analyzed, and certainly not that of the honey from which it is derived. No information on the original honey can be obtained from the analysis of such residues. This is because the composition of the liquid part of the honey is changed by granulation. Therefore, if some or all of the liquid part is removed from partially granulated honey, neither fraction alone will represent the original honey. This point is emphasized because the finding of a high-dextrose residue in these circumstances has led individuals to feel that the original honey had been adulterated with dextrose (corn sugar). In the instance where the commercial laboratory did the analysis, they presumably believed that the sample was honey when it actually was a granulation residue of the type described above. The sender did not seem to realize that its composition would differ from that of the entire lot. With its actual origin unknown to them, they labeled it "adulterated with corn sugar" on the basis of its composition. A large part of the responsibility for this erroneous conclusion would appear to lie with the laboratory for not doing the sampling themselves.

The Difficulty Can be Avoided

Where bulk honey must be heated for pasteurization, then stored for an extended time before packing, it would seem that the potential difficulties described above could be avoided by adding a small amount of fine-grain crystallized honey to each can or to the batch after it has cooled. We have not verified this in practice, however. This would insure that subsequent granulation be relatively small-grained. Furthermore, it should be easier to liquefy it later without requiring extended heating which could cause flavor deterioration. If this is done, care should be taken not to reinoculate the honey with yeasts, the destruction of which was the original reason for heating the honey. This can be done by pasteurizing a batch of honey for this purpose and seeding it with a commercial honey spread.

Granulated State Natural for Honey

The granulated state is the natural one for most honey; only by the expenditure of time and effort can a granulating-type honey be packed so that it will remain liquid for a reasonable time. Our Canadian friends recognize this and market most of their honey in the granulated form. Much of the honey they produce is of the rapidly-granulating type, which is also a persuading factor.

Since honey is known to vary considerably in its composition, its tendency to granulate also varies over a wide range. From the non-granulating types such as tupelo, sage, and spanish needle to such rapid and hard-granulating honeys as dandelion, blue curl, and cotton, there appear to be all degrees of granulating tendency.

The factors influencing honey granulation have been studied over the years, both in Europe and on this continent. There is still much to learn, particularly in finding a good quantitative correlation between honey composition and its tendency to granulate. The earlier workers in this field were handicapped by incorrect results from the inadequate methods of determining the various sugars of honey. Even though rough correlations were found between the actual granulating tendency of honey and the levulose-dextrose ratio (2), de Boer's "crystallizing property" (KV = glucose ÷ non-sugar) (3), Jackson and Silsbee's granulating tendency calculation (dextrose-water) ÷ levulose), or their supersaturation co-efficient (4), in most cases there were so many exceptions to the rules that they were of little practical value. For example, Jackson and Silsbee's calculations showed that even the non-granulating tupelo honey appeared to be considerably supersaturated with dextrose.

With the recent introduction of an improved method of honey analysis (5) an opportunity has arisen to find a closer relation between granulation and composition. Already Austin (6) has suggested that the dextrose:water ratio gives a more realistic picture of granulating tendency than other indices. He based this on a study of 40 Canadian honey samples analyzed by the new method.

We are analyzing over 500 samples of domestic honey representing all commercially important floral types and blends, using the latest procedures. We hope to find suitable relationships between granulation and composition so that predictions of granulating tendency can be made.

Summary

To recapitulate, the liquefying of coarsely granulated honey can be a source of trouble if the honey flows away too rapidly from the granulated part. The remaining part is a crude dextrose hydrate and of course is no longer honey. This type of coarse granulation generally takes place in heated honey. It could be avoided by intentional seeding of such honey after cooling with a small amount of fine-grained honey.

As we learn more about the composition of honey it should be easier to recognize fast-granulating types and treat them accordingly.