

rôle, or for a cheese industry, where both fat and casein are primarily concerned.

Summary.

1. The relation of casein to fat in cow's milk is a variable one.
2. One of the prime factors controlling its relation is individuality.
3. The relation of casein to fat varies among animals of different breeds and among animals of the same breed.
4. Direct determination of both fat and casein seems necessary in determining the value of the milk of any single cow for cheese production.

NOTES.

The Use of the Centrifuge.—Attention has recently been called to the advantage of the laboratory use of centrifugal action for separating crystals from their mother-liquor—a process which has long been of great service in technical operations on a large scale.¹ The object of this note is to point out certain important precautions necessary in the use of this highly serviceable apparatus. The word of caution seems to be especially demanded because new apparatus is being put upon the market by several firms, and the novice may be unfamiliar with the intensity of the centrifugal effect, and the consequent danger inherent in improperly constructed machinery.

It is well known that the forces acting to drain out the liquid in a centrifuge are $\frac{4\pi^2 n^2 r}{g}$ times as great as they would be in a gravity-vat with a perforated bottom, if n = the number of revolutions per second, r the radius, and g = 980.6. Thus if n = 20 (*i. e.*, 1200 revolutions per minute) and the radius of the centrifuge is 10 centimeters, the drying is nearly 160 times as great as that effected by gravity—a very great advantage. It must not be forgotten, however, that the strain upon the apparatus increases in the same proportion, being quadrupled for each doubling of the speed. Therefore with high speeds great strength is necessary. Even great steel fly-wheels sometimes burst under their strain. For this reason, centrifugal apparatus constructed of fragile material should never be run rapidly, and even with the simplest and strongest apparatus, the machine should *always be surrounded by a very strong casing or box of wood or metal*, so that no harm would result if anything should break. For the same reason rapidly revolving centrifugal apparatus should *never be constructed of glass, unless the glass is enclosed in metal in such a way that the fragments will not fly if broken*. Glass apparatus is frequently not well annealed, and is liable to break under the heavy strain.

¹ Richards, *This Journal*, 27, 104 (1905); *Ber.*, 40, 2771 (1907). Kötner, *Chem. Ztg.*, 1907 (No. 73).

At Harvard the funnel-centrifuge, alluded to by Köthner, is made of platinum, but porcelain funnels and receivers may be used without danger if the rate of revolution is not too great. I have never dared to use glass funnels in this apparatus. The porcelain basket-centrifuges, of which several forms are on the market, will stand considerable strain; the speed at which they may safely run varies with the form and stoutness, and should be carefully determined for different loads and indicated by the manufacturer. The porcelain receiver surrounding them is never strong enough to hold the fragments if the basket should break; therefore this whole apparatus also should be surrounded by a strong guard-box. Both porcelain and glass should be supported on some kind of rubber cushion, so as to distribute the strain as evenly as possible.

It is not out of place to call attention to another somewhat less serious but nevertheless important precaution, namely, the equal distribution of the load. This is essential if the apparatus is to run smoothly and the strain is to be evenly distributed. In the case of the funnel-centrifuge the adjustment is very readily accomplished by hanging the opposite funnels upon the two arms of a common balance, and filling them to equilibrium with similar crystals about equally moist. In the case of the basket-centrifuge, the distribution must be made with a spatula, before the machine is started.

If these simple and obvious precautions are taken, the centrifuge will be found, as has been said before, a very valuable aid in the purification of small quantities of substance in the laboratory of the investigator. In the course of twenty years no serious accident has resulted from its use at Harvard, and much has been gained. As has been said before, the gain to be expected varies greatly in different cases; it is greatest in the case of very soluble substances which do not carry impurities in isomorphous solid solution with them into the solid state, and least in the case of slightly soluble substances, which contain isomorphous contamination.

To summarize the contents of this brief note—the value of centrifugal action in purifying substances has been once more emphasized, but the importance of equal distribution of the load, the danger of using glass or other very fragile material in the centrifuge, and the necessity of caution in regulating the speed and in always guarding the operator by a stout casing around the machine, is pointed out.

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Apparatus for the Centrifugal Drainage of Small Quantities of Crystals.—The high efficiency and importance of centrifugal drainage in the removal of mother liquor in purification by crystallization has re-