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VALUE OF OILSEED PROTEINS FOR CHILD FEEDING

by

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This afternoon I would like to confine my remarks to some of our experiences with a variety of cottonseed flours in the diet of recovering malnourished infants.

First, I would like to explain the basis for these studies and the way in which we carry them out so that you can make some sense out of the figures which we are going to present.

We admit severly malnourished infants and, in most cases rehabilitate them with modified cow's milk. Once their recovery is well under way and a satisfactory rate of weight gained, normal serum proteins and normal liver achieved, many of them become subjects for the evaluation of different protein sources.

First, we do comparative studies against milk protein or casein at isonitrogenous and isocaloric levels. Most of our studies are done with the protein contributing 6.4 to 8 percent of the calories. I might remind you that in human breast milk, protein represents about 7 percent of calories and that excellent, high quality, modified cow's milk preparations can be fed at levels of 6.4 percent of calories as protein without showing any adverse manifestations and supporting normal growth.

Some of the newer soy milks, based on a soy-protein isolate enriched with methionine, can also be fed at this level for long periods of time without demonstrating any inferiority.

Most vegetable proteins have to be fed at slightly over 8 percent of calories as protein to maintain normal parameters.

Figure 1 summarizes nitrogen balance studies with four different cottonseed flours. CF-22 is the commercially available PROFLO; CF-21 is a glanded cottonseed flour prepared by azeotropic solvent extraction; CF-27 is another batch of the same product; and CF-26 is a flour from glandless cottonseed.

The first set of columns for CF-22 shows nitrogen absorption and retention for milk, the cottonseed flour, and then again for milk. These were done consecutively. The stippled area of the columns

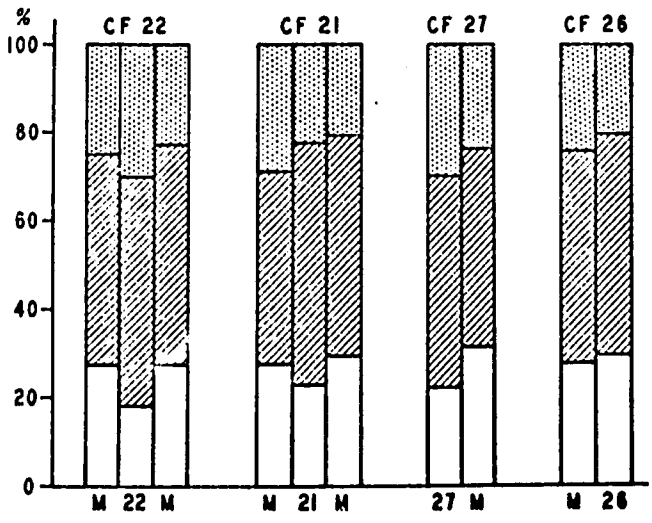

Figure 1.—Nitrogen balance studies with four different cottonseed flours.

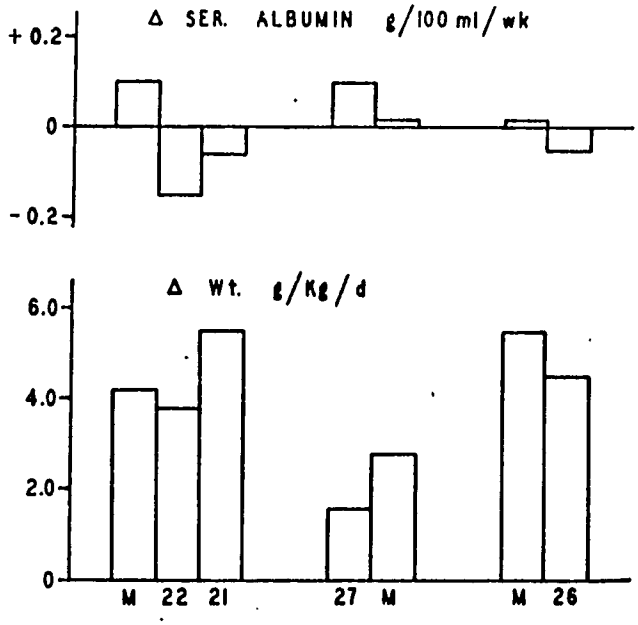

Figure 2.—Weight comparison.

represents the stool nitrogen, the cross-hatched area urine nitrogen, and the clear area apparent nitrogen retention. You can see that the absorption of nitrogen from CF-22 was significantly inferior to that of milk—both before and after. The retention of nitrogen is definitely lower.

For the azeotropic solvent extracted flour, CF-21, you can see that the absorption of nitrogen was better than it had been for milk at this point and inferior to what it was afterwards. This is probably a slight artifact. Some of these children showed temporary intolerance to lactose and this affects their absorption of nitrogen. The retentions were inferior to milk, but as you can see it is at a definitely higher level than that of the CF-22, confirming the differences in PER that have been consistently reported.

With this second batch, CF-27, the study was done a little differently. There was no preceding milk period. The absorption of nitrogen here was relatively low as compared with the previous batch. The retentions were almost identical. In the milk periods that followed, you can see an improvement in absorption and a very definite improvement in retention. I might add that when you give milk protein after the prolonged feeding of almost any vegetable protein, with few exceptions, you will get retentions of nitrogen which are superior to those you get on prolonged milk feedings, suggesting that some protein stores have been repleted.

With the glandless cottonseed flour, the order is reversed. Here milk was given first and then the CF-26, as we call it. You can see that the absorption of nitrogen is very good, better than it was for the other cottonseed flours. The retentions were slightly better than those for the solvent-extracted flours.

At the bottom of figure 2 is a comparative demonstration of the changes in weight gain during the same periods during which we were measuring nitrogen balance.

Note the change in serum albumin. With milk there was a slight improvement. With CF-22, there was a definite fall. With CF-21, there was a slighter fall. I point this out to show the unreliability of short-term weight gain in children as an indicator of protein quality. From weight gains here, you would think that CF-21 was definitely superior to milk and that CF-22 was almost as good as milk. If these studies were prolonged for many weeks or months and these rates of weight gain and rates in fall of serum albumin continued, these children would develop fatty livers, hypoalbuminemia, and eventually edema. But, in practice, what happens with cottonseed flour—not with all proteins—is that on prolonged feeding the rate of weight gain falls off and the serum albumin tends to stabilize at levels that are slightly below those achieved with milk. But there are no adverse reactions.

By contrast with some other proteins—for instance, with full fat soy flour that has not had methionine added to it, the superior rates of weight gain continue in accord with the higher PER. But if the feeding is continued for a matter of 2 or 3 months, these children will develop fatty livers and a very significant fall in serum albumin, which, if continued, would eventually result in edema and other manifestations of Kwashiorkor. This comparison here between the CF-27 and milk was done at a different time and with different subjects; the rate of weight gain was definitely less for the CF-27 than for milk. Both produced no fall in serum albumin. This is to be expected with the lower rate of weight gain.

With the glandless cottonseed flour, we have excellent rates of weight gain but a slight fall in serum albumin.

With more prolonged feeding of the CF-27 or the CF-26, we have encountered other manifestations which at first we thought were characteristic of cottonseed flour. We have since encountered them with casein as well, and we suspect that they are due to a deficiency of a micronutrient in our purified diet.

The most critical test, in our estimation, of protein quality is the ability to correct severe malnutrition. In other words, this would be the equivalent of a repletion study.

If we take infants admitted with Kwashiorkor, edema, hypoalbuminemia, and severe fatty livers and feed them cottonseeed flour as the only source of protein in the diet, we have encountered remarkedly good results. As I pointed out to Dr. Milner, these were quite unexpected. The retentions of nitrogen from cottonseed flour in this very critical situation are excellent, diuresis is very prompt, and serum albumin recovers almost as rapidly as it does with milk.

By contrast, fish protein concentrate which has a significantly higher PER and supports a better rate of weight gain, confirming the PER, is not able at normal levels of protein intake to regenerate the serum albumin and correct the fatty liver.

These differences in quality in different situations, I think, merely indicate to us that we must be a lot more critical in the evaluations of proteins being considered for infant feeding than just to depend on the PER in rats.

This morning, one of the members present brought out the differences between the PER values and the weight gain in chickens. I might suggest that neither one is an adequate indicator of protein quality for the human infant.

I was pleased to see that in the development of the Vitasoy, the percentage of calories as protein was given at something like 16 percent. This seems perfectly safe for a protein with a PER of 2. I emphasize this because, along with some of the other impressive specifications which we heard from the Food and Drug Administration in their proposed regulations, a definition of a substitute for human breast milk has been included which must contain no less than 1.8 grams of protein per 100 calories. This is the protein content of human breast milk. I doubt that in our lifetime any of our laboratories are going to come up with proteins that compare to human breast milk in quality. The proposed regulation goes on to state that the quality of this protein must be at least 70 percent that of casein. Although it does not define it, I presume that this refers to it as having a PER—70 percent of that of casein. Casein is not equivalent to human breast milk protein to begin with, and a PER of 70 percent of that of casein fed at such levels could be guaranteed to produce Kwashiorkor in a significant percentage of infants.