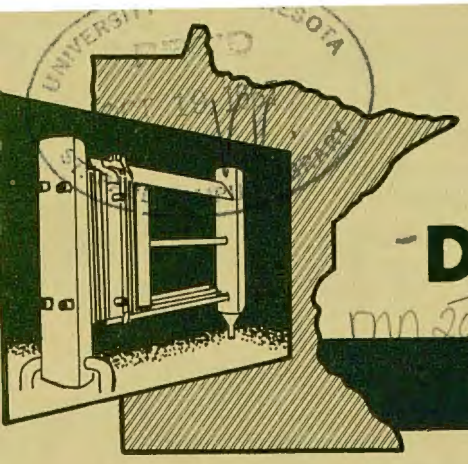

Minnesota Dairy Products Processor

AGRICULTURAL EXTENSION SERVICE • INSTITUTE OF AGRICULTURE
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WHAT IS THE BUTTERFAT CONTENT OF YOUR BUTTER?

You've just finished a churning of butter and it's printed or bulked and ready for shipment. It's a good churning of butter. The butter is properly worked and probably won't leak. Composition will remain stable.

Someone now asks you what the butterfat test of that churning is. You go to your records and tell him 80.3 percent. But is it 80.3 percent? Did you test it after you added makeup water? How many samples did you test? From where were those samples taken? Did you actually run a butterfat test or simply make a moisture analysis?

These are some of the questions that must be answered before your reply of 80.3 percent can be considered much more than a reasonable guess. And these are questions which must be considered if you are to minimize fat losses and, at the same time, be assured of a legal 80.0 percent fat content.

ANOTHER WAY TO LOOK AT IT

According to USDA records on data collected in 1965 the average butterfat test of butter was 80.4 percent. The range in test, from highest to lowest test of individual churnings was 0.3 percent. Let's assume that this is the situation in your plant. After working the butter you take a sample and analyze it for butterfat. Your reading on the Kohman balance says 80.4 percent butterfat. Now we'll ask the same question we asked before, "What's the fat test of the butter?" Statistics tell us that the actual test is somewhere between 80.1 and 80.7 percent. That's all one sample has told you.

Suppose now, that you wanted to be very sure of the butterfat test of a churning of butter--contest butter for example. Instead of taking one sample, you take four. You find the average of these four tests is 80.4 percent butterfat. How sure are you now that this is the true test? More sure, you say? But how sure?

In truth you can be certain only that the true test lies somewhere between 80.2 and 80.6 percent. You've narrowed the range by making four tests, but a range still exists.

Of course the important question one must ask is, "What kind of composition control do we exert on butter when we either (1) sample once and then only

to determine the amount of makeup water to add or (2) take a second sample later to determine the finished product composition?" Is this effective composition control?

ANOTHER QUESTION

Someone wants to sell you a new Kohman balance because, as the salesman says, this new model is more sensitive. You would expect, by using it, to effect better composition control because you can make more accurate weighings. So you buy it and use it for awhile. Question: How can you tell whether or not you have actually tightened your control over butter composition?

WHAT ARE THE ANSWERS?

The answers to most of these questions fall within a realm of science called "statistical quality control." Perhaps in the problems we're posing here we should refer to it as "statistical composition control." But the point is there are ways to find answers. To do so you must collect data to develop control charts.

HOW TO DO IT

1. Take three samples of butter from a finished churning. Determine the butterfat test on each sample. Average the results. Do this on each churning and you will soon have sufficient data to know the average test of your butter.

2. Determine the range in test between the highest and lowest readings of the three tests made on each churning. If your three analyses showed 80.1, 80.3 and 80.4 percent, the range is 0.3 percent (80.4-80.1=0.3). After several churnings average the range i.e. add up the range value on each churning and divide by the number of churnings.

You now have the data needed for setting up control charts. But on each churning you will need to run three samples for butterfat test; average your results and also determine the range.

SETTING UP CONTROL CHARTS

An example of a control chart is shown in figure 1. It is from unpublished data of the USDA. It can be used as a guideline. Here's how it is set up:

(Chart A)

1. Draw a line across the graph at your average test (in this example 80.4 percent).

2. Calculate control limits:

(a) Upper control limit = average test + (1.023 x range)

(b) Lower control limit = average test - (1.023 x range)

Since the range was 0.3 our control limits are 80.4 plus and minus 0.31, or 80.71 and 80.09 respectively. Lines may then be drawn across the chart at these points to provide visual observation of control status.

3. Calculate a lower warning level: Average test - (.682 x range ave.) or 80.4 - (0.682 x 0.3) = 80.2

4. The points which are placed on chart A are the average of the three fat tests made on each churning.

(Chart B)

1. Draw a line across the chart at your range average (in this case 0.3 percent)

2. Calculate the upper control limit: Range x 2.574 or, in this example 0.3 x 2.574 = 0.77

3. The points placed on this chart are the range values that are noted between the highest and lowest reading of the three tests made on each churning.

WHAT THE CHARTS TELL YOU

The charts that are shown in figure 1 may be considered fairly realistic. These are USDA data and indicate the kind of control currently being exerted on butter composition.

Chart A:

1. When the points fall below the "lower warning limit" you are in danger of the churning being below the legal standard for fat in butter.

2. Points below the "lower limit" are basis for believing the butter may be illegal.

3. When the points are high (churning 11) you can be assured that you're giving away far too much butterfat. When the points are low (churning 12) you can be sure that further tests will likely prove the butter is illegal.

4. The points on this chart should vary closely around the "lower warning limit" line. Doing so means the operation is efficient (fat giveaway is minimal) and the butter will meet the 80.0 percent legal standard for butterfat.

Chart B:

1. When the points vary widely the operation is out of control. Note churnings 11 and 12. The test results were actually (79.5, 81.2, and 80.7) and (79.9, 81.1, and 80.2) respectively. A situation such as this calls for immediate change in churning procedure. The operation is out of control. Moisture is not evenly distributed.

2. Ideally the points on this chart should vary only slightly and remain under the Range Maximum line. This is assurance that the operation is under control.

Now then, back to the question about the benefit to your operation of a new, more sensitive balance for determining butter composition. If, with the new balance, your range values are narrowed (variations from point to point are smaller) the balance is allowing you to do a better job.

IS IT WORTH THE EFFORT?

This is something that only you can determine. It is apparent that tighter controls could be applied in most cases. Whether they would be worth the labor required to run three tests per churning depends on your present ability to maintain uniform butter composition within a reasonable range of butterfat test. But do you know, under your present operating conditions, whether you are able to do this or not?

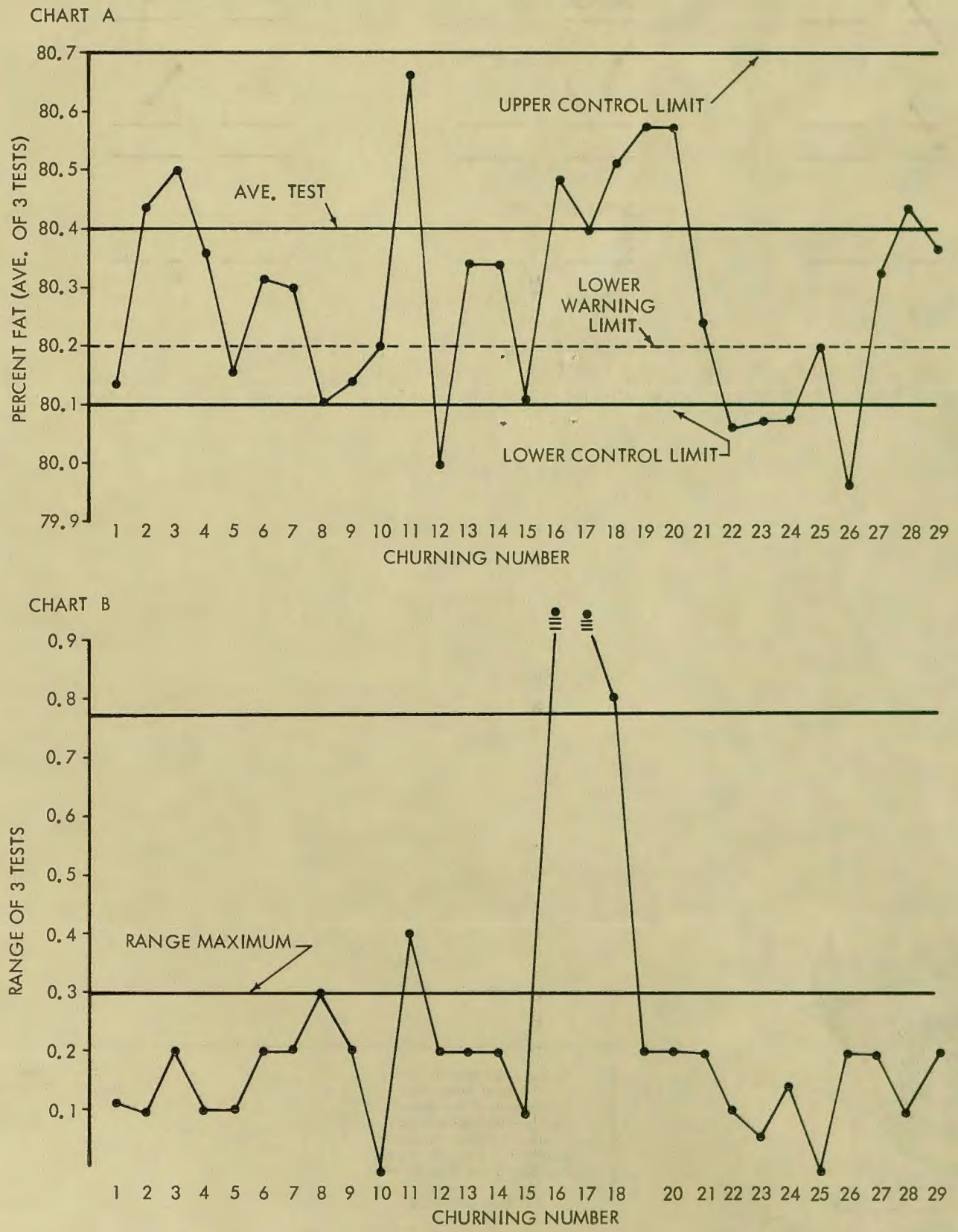
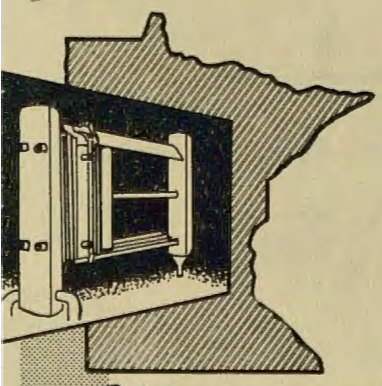


Figure 1. A sample control chart (from unpublished USDA data).



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