Title: Will adding non-fat dry milk solids improve the taste and palatability of skim and 2% fat milk?

Abstract:

This experiment tested if adding non-fat dry milk solids to skim milk and 2% milk would improve the taste and palatability to be more like whole milk. Whole milk has more fat and cholesterol but a better taste and thicker viscosity that people like better. By adding the non-fat dry milk solids to skim and 2% the taste should improve without adding any fat, making them a more desirable and healthier choice to consumers. Two tests were done to test the change in viscosity, a pipette test and a Brookfield viscometer test. In the pipette test a 10mL pipette was filled and then timed to see how fast the milk ran out, it was found the modified skim and 2% did have an increased time as opposed to non-modified. The Brookfield viscometer test also found that the viscosity was increased, however not quite to the level of the whole milk standard. A taste test was conducted to see if the taste was improved. The test conducted was a triangle test, the 3 choices were, whole milk, the unmodified milk and the modified milk. The tasters were then asked to pick which two milks tasted the same. The taste tests found that most people could indeed taste the difference of adding the non-fat milk solids.

Introduction:

The purpose of this project was to see if adding non fat dry milk solids to skim and 2% fat milk would change the viscosity and palatability to be more like whole milk. Skim milk and 2% milk have less fat and cholesterol than whole milk. All milk types have the same amount of carbohydrates and protein but differ in their fat content. Whole milk has 8 grams of fat per cup, compared to 2% which has 5 grams of fat per cup and
skim milk which has 1 gram of fat per cup (American Dietetic Association, American Diabetes Association, 2003). In 1994 a study was conducted to compare blood lipid levels of men age 20-36 that drank whole milk and skim milk (Steinmetz, Childs, Stimson, Kushi, McGovern, Potter and Yamanaka, 1994). After 6 weeks the study found that the mean total cholesterol for the skim drinkers was 4.47 mmol/l and the whole milk drinkers mean total cholesterol was 4.80 mmol/l (Steinmetz, Childs, Stimson, Kushi, McGovern, Potter and Yamanaka, 1994). This suggests that making the switch from whole to skim may help lower the risk of coronary heart disease (Steinmetz, Childs, Stimson, Kushi, McGovern, Potter and Yamanaka, 1994). Many people however do not like the taste of skim or 2% milk, to them it tastes watery. In a survey that was conducted it was found that whole milk drinkers choose their milk based on satisfaction instead of on health and nutrition (Miles, Schwager, Lenz, 1995).

What if there was a way to have less cholesterol and fat like skim and 2% milk but the taste and viscosity of whole milk? To do this non-fat dry milk solids were added to skim and 2% milk. The three flavor components in milk are fat, lactose and protein. The non-fat dry milk solids have lactose and protein but no fat; therefore they should improve the taste without adding the fat.

The non-fat dry milk solids were added to 500mL of skim milk and 2% and mixed with a spoon. After the solids were added a Brookfield viscometer test and a pipette test were conducted. For the pipette test a 10mL pipette was filled with milk and timed to see how fast the milk ran out of the beaker. The independent variable was the amount of non-fat dry milk solids and the dependent variable was the viscosity.
Methods:

For this experiment whole milk was used as the control to compare the modified milk to. Unmodified skim and 2% milk were also given the pipette test and measured with the Brookfield viscometer so that they could be compared with the modified milks results. Three trials were conducted on two different days. The controls were measured the day of the first trial and were measured once.

To figure out how many non fat dry milk solids to add the difference in the amount of fat in whole milk and the fat in skim and 2% per 100 grams was taken and then multiplied by 5 for the 500mL used. The figures for the composition of milk that were used were found on a USDA website. To skim milk 15.35 grams were added to 500mL and to 2% milk 8.75 grams were added to 500mL.

The solids were mixed into 500mL of milk with a spoon and then tested. The first test was the pipette test. A 10mL pipette was filled and then timed to see how fast the milk flowed out. The second test was a Brookfield viscometer test. The spindle used was the largest one because it would give the best reading since it had the largest surface area and the spindle speed was 14s.

The final test was a sensory evaluation test. A triangle test was used and 6 people were tested each trial. The three milks used in the test were whole milk, the modified milk and the unmodified milk the taster was then asked which two milks tasted the same. The scorecard looked something like this:

**Which two samples taste the most alike?** 945, 717, or 882
To prevent bias the samples were given a random 3 digit number and set up like a triangle. The samples were also in clear plastic cups.

**Discussion/Results:**

By adding the non-fat dry milk solids the viscosity of skim milk and 2% should be increased to be more like whole milk. A project similar to this one only adding protein to yogurt instead of milk found that adding the proteins added to the viscosity (Guzman, 1999). The three flavor components to milk are fat, protein and lactose. The non-fat dry milk solids have lactose and protein so therefore they should add to the flavor without adding the fat.

The controls were whole milk and skim and 2% unmodified. The controls were tested with the pipette test and the Brookfield viscometer test as can be seen in Table 1, this is the standard all the trials were compared to.

In the first trial the time took for the modified skim milk to run out the pipette increased 3 seconds and for the 2% it increased 2 seconds, neither however reached the same level as whole milk. Modified skim and 2% also increased in the Brookfield viscometer test, but once again not to the level of whole milk. These results can be seen in Table 2.

The second and third trials were conducted on the same day from the same gallons of milk. The grams of non-fat dry milk solids were also round off from 15.35 grams to 16 and 8.75 grams to 9 to see if this would get results closer to whole milk. The biggest change as can be seen in Tables 3 and 4 was the results with skim milk. In both trials the viscosity of skim milk went up to 690. According to the Brookfield viscometer
test the viscosity of 2% milk actually went down a little bit to 690 in trial 2 and 680 in trial 3 compared to 710 in trial 1.

For the triangle test most people could pick out the modified milk but they did not think it tasted exactly like whole milk. When asked they said the modified milk tasted sweeter and creamier and could taste a difference between the modified and unmodified milk. No one thought that the modified milk tasted exactly like whole.

The experiment did work in the sense that it did change the flavor and the viscosity of the milk; however the results were not exactly the same as the whole milk control. For the experiment to be more successful more non-fat dry milk solids should be added.

If this experiment were to be conducted again many changes could be made. The first would be to increase the amount of non-fat dry milk solids. The pipette test should also be increased from 10mL to something larger. 10mL is really not enough volume to time and the results show that there was not much difference in any of the times. The modified milk was tested right after the solids had been added, it would be interesting to have it sit in the fridge for 24 hours and see if that affected anything. It would also be interesting to bake something that calls for whole milk with the modified milk and see how it affects the outcome of the recipe.

There could have been many sources of error in this experiment. The pipette test could not have been very accurate since it was only 10mL. Since milk is not very viscous to begin with the Brookfield viscometer might not have been the best way to measure the change in viscosity.
The experiment did indeed work, however more tests should be done to find the optimum amount of non-fat dry milks solids that should be added.

Table 1: **Standards**

<table>
<thead>
<tr>
<th>Pipette Test (sec)</th>
<th>Brookfield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole 12</td>
<td>740</td>
</tr>
<tr>
<td>Skim 6</td>
<td>580</td>
</tr>
<tr>
<td>2% 8</td>
<td>600</td>
</tr>
</tbody>
</table>

Table 2: **Trial 1 Results**

<table>
<thead>
<tr>
<th>Pipette Test (sec)</th>
<th>Brookfield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skim 10</td>
<td>630</td>
</tr>
<tr>
<td>2% 10</td>
<td>710</td>
</tr>
</tbody>
</table>

Figure 1: Skim results from trail 1 Brookfield viscometer
Figure 2: 2% results from trial 1 Brookfield viscometer

Table 3: **Trial 2 Results**

<table>
<thead>
<tr>
<th>Pipette Test (sec)</th>
<th>Brookfield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skim</td>
<td>9  690</td>
</tr>
<tr>
<td>2%</td>
<td>9  690</td>
</tr>
</tbody>
</table>

Figure 3: Skim results from trial 2 Brookfield viscometer
Figure 4: 2% results from trial 2 Brookfield viscometer

Table 4: Trial 3 Results

<table>
<thead>
<tr>
<th></th>
<th>Pipette Test (sec)</th>
<th>Brookfield (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skim</td>
<td>9</td>
<td>690</td>
</tr>
<tr>
<td>2%</td>
<td>10</td>
<td>680</td>
</tr>
</tbody>
</table>

Figure 5: Skim results from trial 3 Brookfield viscometer
Figure 6: 2% results from trial 3 Brookfield viscometer

References


