

Acceptance of 2% Ultra-Pasteurized Milk by Consumers, 6 to 11 Years Old

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ABSTRACT

The objective of this study was to determine the degree of liking of ultra-pasteurized (UP) milk by 6 to 11 year olds. For comparative purposes, 2% UP milks were evaluated along with 2% conventionally pasteurized high temperature short time (HTST) and 2% ultra high temperature (UHT) milks. A seven-point facial hedonic scale with Peryam & Kroll verbal descriptors for affective testing with children was used with the 6 year olds. For the older children, a seven-point hedonic scale with Peryam & Kroll verbal descriptors was used. The mean degree of liking of UP milk was rated as slightly below "good." HTST milk was liked slightly more than the UHT milk, which was liked slightly more than the UP milk. How the children felt about milk, in general, significantly affected how much they liked the test milks, with all milks being influenced equally.

(Key words: ultra-pasteurized, ultra high temperature, fluid milk)

Abbreviation key: P & K = Peryam & Kroll, UP = ultra-pasteurization.

INTRODUCTION

Milk products are commonly regarded as important dietary sources of protein, minerals, and vitamins. Despite these nutritional benefits, milk consumption by US consumers typically bears an inverse relationship with consumer age, with the decline in per capita consumption beginning as early as ages 6 to 12 (Milk Industry Foundation, 1999). In fact, milk consumption by 6 to 12 year-old children in 1997 was reported as 10% less than that consumed by 0 to 5 year-old children (Dairy Management Inc. Planning Research Group, 1999). In contrast, carbonated soft drink consumption was 176.8% greater among the 6 to 12 year-olds than among the younger group. Furthermore, according to a USDA survey, calcium intakes for girls aged 12 to

19 are as low as 64% of the Recommended Dietary Allowance (Katz, 1998). One mechanism for simultaneously increasing milk consumption and calcium intake may be to provide dairy products that appeal to children so that they willingly choose to drink milk. This strategy may be accomplished at least partially by producing milk products that retain quality attributes throughout product shelf-lives.

To date, fluid dairy product quality and shelf-life extension strategies have focused primarily on increasing thermal processing conditions in combination with protecting products from post-pasteurization contamination. To illustrate, conventional HTST pasteurized milk is heated to 161°F (72°C) for a minimum of 15 s or the equivalent (FDA, 1999). This product is usually coded for a last-day-of-sale between 10 and 21 d of refrigerated storage after the date of processing. In contrast, ultra-pasteurized (UP) milk is heated to 280°F (138°C) for at least 2 s and generally has a shelf-life of several weeks under refrigerated conditions (Boor and Nakimbugwe, 1998). Commercially sterile UHT milk, which has a thermal treatment similar to that of UP milk, is aseptically packaged in addition, yielding products that are shelf stable for several months.

Within recent years, US fast-food establishments have begun to market UP milk products (Boor and Nakimbugwe, 1998), thus establishing the nationwide distribution and availability of extended-shelf-life fluid milk products. An expert adult panel has determined that UP milk can produce organoleptically acceptable fluid milk products (Boor and Nakimbugwe, 1998), but these products have not been formally assessed by children. Children and adults are recognized to differ in their acceptances of various food products (Lavin and Lawless, 1998). Therefore, the objective of this study was to determine the degree of liking of the newly widely available 2% fat UP milk by 6 to 11 year olds in reference to their degree of liking of conventionally pasteurized 2% fat HTST milk as well as of 2% fat UHT processed milk.

MATERIALS AND METHODS

The following milks were tested: 2% conventionally pasteurized HTST, UP, and UHT milk. The UP and

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Table 1. Age (days) of milk at test date.

Test date	HTST	UP ¹	UHT
Aug. 3	1	7	24
Aug. 4	1	6	25
Aug. 5	1	7	26
Aug. 9	1/2	6	30

¹Ultra-pasteurized.

HTST milks were packaged in paperboard gable-top containers (polyethylene paperboard and polyethylene), while UHT milk was in aseptic barrier containers (polyethylene, aluminum foil and polyethylene). The milks were presented to panelists at the manufacturer's recommended optimum time postpasteurization. HTST was tested within 36 h of pasteurization, while UP milk was tested at 6 or 7 d post pasteurization, and UHT milk was tested 24 to 30 d postpasteurization (Table 1). Each child tested four samples of milk, with each child testing two UP milk samples. Approximately 17 children participated in each of six testing sessions. All testing sessions were completed within 1 wk.

Participants

A preliminary test was conducted to determine whether participants could understand and follow the directions on the ballot. The panelists consisted of 6 to 11 year old children from the Ithaca, New York, area. Seventy-nine children from Cornell University summer day camp program and 26 children from Enfield (a suburb of Ithaca) summer day camp program participated in this experiment. The panel consisted of those who were not allergic or lactose intolerant to milk, whether they liked milk or not. Children who didn't like milk were identified for research purposes. Before the test, consent forms were signed by a parent or guardian. The children were asked their age, sex, and how much they liked milk in general. The subjects received an ice cream treat as a reward for their participation.

Sensory Analyses

A seven-point facial hedonic scale with Peryam and Kroll (P & K) verbal descriptors for affective testing with children (Kroll, 1990; Resurreccion, 1998) as listed in Table 2, was used for the 6 year olds. As the older children could read, they were tested with only the P & K verbal scale. The containers of milk were mixed by inversion, then, in dim light, 60 ml of milk was poured into 148-ml plastic cups, capped with the appropriate lid and then placed in a box to protect it from light. Milk at approximately 10°C was presented in a balanced order to panel members, who were seated in indi-

Table 2. The P & K Verbal Scale for Affective Testing with Children.

Rating	Description
1	Super bad
2	Really bad
3	Bad
4	Maybe good or maybe bad
5	Good
6	Really good
7	Super good

vidual booths. The children were instructed to sample the milk as they normally drink milk. The Compusense five (Compusense Inc., Guelph, Canada) computerized data collection system was used to determine the order of presentation of the samples, to develop the questionnaire, and to collect the data.

Statistical Analyses

Statistical analyses were performed using the general linear models, paired *t*-test, and Tukey paired comparison test (Minitab release 12, State College, PA). For the general linear model, panelists were treated as repeated measures. "Liking milk in general" was nested within panelists. Since "age" and "gender" of the panelists, "camp" and "processing date of the milk" and "test date" were not significant, these factors were dropped from the model in subsequent analyses. An overall *F*-test indicated a significant difference between treatment means, therefore, paired *t*-tests and Tukey paired comparisons were used to determine where the means were different. Significance of differences was defined at *P* < 0.05.

RESULTS AND DISCUSSION

Treatment

The mean liking scores for UP, HTST, and UHT milks were 4.7, 6.0, and 5.3, respectively, on the seven-point hedonic scale. Differences among means were significant, as shown in Table 3. (There was no significant difference between duplicate UP samples; Table 4). A

Table 3. The ANOVA of liking intensity of milk.

Source	df	Adj MS	F	P
Like ¹	1	42.076	8.54	0.004
Panelist (like)	96	5.260	2.75	0.000
Treatment	2	55.789	29.12	0.000
Like*treatment	2	0.993	0.52	0.596
Error	290	1.916		
Total	391			

¹Like unflavored milk in general (like milk somewhat vs. like milk very much).

Table 4. Mean liking ratings (\pm standard deviation) and paired student's *t*-test.

Age group ¹	HTST	UP ²	<i>t</i> -test	UP	UHT	<i>t</i> -test
6 to 8	6.3 \pm 1.0	4.7 \pm 2.0	p = 0.000	4.7 \pm 2.0	5.4 \pm 1.9	p = 0.004
9 to 11	5.7 \pm 1.4	4.7 \pm 1.5	p = 0.002	4.7 \pm 1.5	5.3 \pm 1.4	p = 0.029
All	6.0 \pm 1.2	4.7 \pm 1.8	p = 0.000	4.7 \pm 1.8	5.4 \pm 1.7	p = 0.000

¹Data on those children who like milk.

²Ultra-pasteurized.

possible explanation for the significant preference for HTST milk may be familiarity of the taste of HTST milk served at school and at home. Familiarity has been shown to influence children's food preferences (Alles-White and Welch, 1985; Sullivan and Birch, 1990). Preferences for HTST milk over UHT milk in the adult US population is also apparent. Horner et al. (1980) found a linear relation between the percentage of UHT milk in a sample containing both UHT and HTST milks and degree of dislike; the higher the percentage of UHT milk, the lower the average preference score. Average preference scores for HTST milk on a nine-point hedonic scale with "9" as "like extremely" showed that whole HTST milk received a score of 7.6, while a 75% UHT/25% HTST milk received scores of 6.6. If these scores are transposed to a seven-point scale, HTST would be 5.9, while UHT would be 5.1, which are similar to this study's scores of 6.0 and 5.3, respectively. The differences in ratings between the UHT milk and the UP milk are worthy of further study.

The percent of ratings distributed across the P&K hedonic scale is shown in Figure 1. Although UP milks had a higher percentage of "good" scores than either HTST or UHT milk, the HTST and UHT milks had higher "really good" and "super good" percentages than the UP milks.

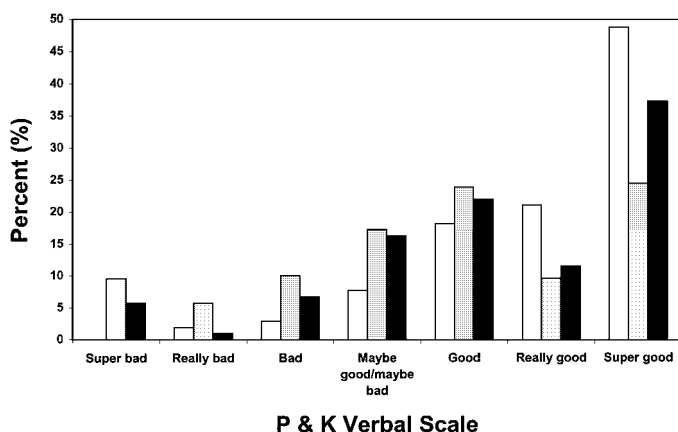


Figure 1. Distribution of ratings of milk, using a seven-point hedonic scale. Legend: white bar represents HTST milk, gray bar represents ultra-pasteurized milk, and the black bar represents UHT milk.

Effect of Liking of Milk in General

Before the panelists rated the milk, they were asked how much they liked unflavored milk, in general. This degree of liking of milk, in general, had a significant effect on the rating of the test milks, both when all of the panelists were included as well as when only those who "liked" milk were included. When all of the children's scores were included, the children were classified into three groups, as follows: those who do not like milk, those who like milk "somewhat" and those who like milk "a lot." In the ANOVA model, the group of children who do not like milk were excluded from the analysis, as the model must have at least two factor levels in each level of nesting factor. The interaction of "liking of milk in general" with treatment was not significant, which means that the effect from "liking of milk in general" did not vary with milk treatment. Figure 2 shows the mean hedonic scores of the three milks by degree of "liking of milk in general." Children who did not like milk scored all three milks lower than those who liked milk "somewhat," who scored milk lower than those who really liked milk in general.

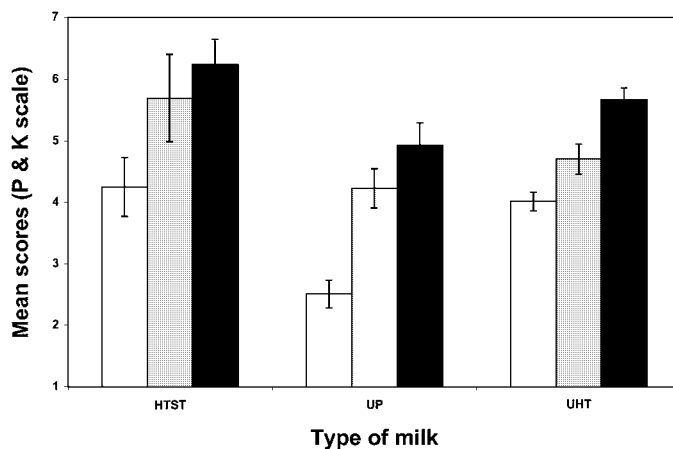


Figure 2. Mean hedonic scores of three types of milk by degree of liking of milk. Legend: white bar represents the children who don't like milk, gray bar represents the children who like milk "somewhat," and black bar represents the children who like milk "very much."

Effect of Age and Gender

There was a significant effect of the scoring of the test milk due to the panelist, therefore age and gender of the children were tested to see if these variables could have influenced the rating of the milks. ANOVA results showed that neither age nor gender was a significantly influential factor. The lack of significant influence due to gender and age is contrary to several studies. Young subjects (9 to 15 years old) showed clear gender differences in preference for various sucrose water solutions (Desor et al., 1975; Ennis et al., 1979). With dairy products, sex and age influenced sensory evaluation of sugar and fat for 10 to 19 year old panelists (Monneuse et al., 1991).

Effect of Processing Date of Milk, Test Date, and Camp in Attendance

As the test milks were not processed on the same date and the sensory evaluations were not performed on the same day, these factors were tested to see if these differences could have affected product rating. The ANOVA showed that both the processing date and the test date were not significant, therefore processing date and test date were not factors influencing the differences in ratings. As the children attended two different camps, ANOVA was performed to see if there was an effect due to the camp attended. The effect was not significant.

CONCLUSIONS

The mean degree of liking of UP milk was rated slightly below "good" by children ages 6 to 11. The children preferred HTST to UHT milk, which was preferred over UP milk. As UP milks are often distributed in fast-food establishments, which are commonly frequented by children in this age group, attention should be directed toward making these products appeal to children more. Children's opinions regarding milk consumption

in general significantly affected how much they liked the test milk, but all milks were equally influenced by this factor.

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