RESEARCH REPORT
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Shelf-Life Study of Pasteurized Whole Milk When Treated With New Stainless Steel Spiral Microchip Device (5NSS5450/2-1104)

prepared for

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Objective

The objective of this study is to determine the efficacy of a new stainless steel spiral microchip device on microbiological shelf life of pasteurized whole milk when stored at refrigerated temperature (40°F).

Materials and Methods

Test Product

A new stainless steel spiral microchip device (5NSS5450/2-1104) was used in this study.

Test Sample

Three 1-gal commercially pasteurized whole milk samples were used in this study. The milk samples were purchased from a local grocery store on December 10, 2004 with an expiration date of December 24, 2004. The study was initiated on December 10, 2004.

Sample Analyses

The milk samples were divided into two portions. One portion served as a negative control (untreated). One portion was passed through the new stainless steel spiral microchip device three consecutive times. This milk sample was then was combined with untreated milk sample at a ratio of 4.5:95.5 wt/wt (treated : untreated). Control and the 4.5% treated sample were stored at 40°F. A single 25-ml sample was analyzed initially (day 0) and at days 2, 4, 6, 8, 10, 12, 13, 14, 15,16, 18, 20 and 22 for aerobic bacteria, psychrotrophic aerobic bacteria and pH. Oxidation properties of the samples were determined initially (day 0), and at day 22. The methods of analyses are outlined in the following table.

Test	Medium	Incubation Time/ Temperature/ Atmosphere
Aerobic Plate Count	Tryptone Glucose Yeast Agar	2 days/32°C/aerobic
Psychrotrophic Aerobic Plate Count	Tryptone Glucose Yeast Agar	10 days/7°C/aerobic
pH	Accumet AB15, Fisher Scientific	Ambient temperature
Oxidation	Peroxide value	AOCS Cd 8b-90

Results and Discussion

The taste, odor, and appearance of a food (organoleptic qualities) are the ultimate criteria used by consumers to judge a food's acceptability. These qualities begin to change as the microflora - bacteria, yeast, and mold- in the food grow and metabolize available nutrients. Organoleptic changes are

generally not detectable until the microbial population is high. The number of organisms required to cause spoilage varies with the food item and the type of microorganism growing in it.

Aerobic plate count (APC) results of the control and 4.5% treated milk samples are shown in Table 1. In the control sample, total aerobic plate counts gradually increased from 20 up to 15,000,000 colony-forming units per milliliter in 10 days. In the microchip treated milk sample, total aerobic plate counts increased from less than 10 up to 14,000,000 colony-forming units per milliliter in 10 days. Aerobic plate counts of the control sample continued increasing after 10 days and reached 1, 200,000,000 colony-forming units per milliliter after 20 days. Counts of the 4.5% treated milk sample followed somewhat steady level and ranged from 6,300,000 to 83, 000,000 colony-forming units per milliliter from day 10 to day 22 (Figure 1).

Psychrotrophic plate count results of the control and 4.5% treated milk samples are shown in Table 2. In the control sample, psychrotrophic plate counts gradually increased from less than 10 up to 15,000,000 colony-forming units (CFU) per milliliter in 10 days. In the 4.5% treated milk sample, total psychrotrophic plate counts increased from less than 10 up to 17,000,000 colony-forming units per milliliter in 10 days. Psychrotrophic plate counts of the control sample continued increasing after 10 days and reached 3, 900,000 colony-forming units per milliliter after 20 days. Counts of the 4.5% treated milk sample followed somewhat steady level and ranged from 2,700,000 to 83, 000,000 colony-forming units per milliliter from day 10 to day 22 (Figure 2).

The rate of the microbial growth influences the self-life of foods. The shelf life of a given food product is determined by chemical, physical and microbiological changes. In milk, the spoilage organisms may utilize lactose and produce lactic acid. Acid production can reduce the pH of the milk to 4.5 where curdling takes place. The pH values of the control and 4.5% treated samples are shown in Table 3. After 22 days of storage the pH value of the control sample gradually decreased from the initial level of 6.7 to 5.0. On the other hand, the pH value of the 4.5% treated milk sample followed a steady pattern and was 6.4 after 22 days.

Oxidation, one of the most important chemical reactions that occur in food, has significant effect on both the quality and acceptability of food products. The peroxide value (PV) test is one of the most common tests used to evaluate the extent of lipid oxidation. This method measures peroxides that are the main initial products of antioxidation during storage. Peroxide value is expressed as milliequivalents (meq) of oxygen per kilogram of fat. The initial PV of the milk sample was less than 0.12 meq/kg. After 22 days of storage, PV in the control sample was 0.35 meq/kg while the 4.5% treated sample was only 0.13 meq/kg (Table 4).

Overall, higher pH value and lower aerobic,plate counts, psychrotrophic plate counts and lower peroxide value in the 4.5% treated milk suggested that the microchip device had a positive effect to extend the shelf life of milk.

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Table 1. Aerobic plate counts (CFU/ml)* of control and 4.5% treated milk samples stored at refrigerated temperature, 40ºF.

Interval	Control (CFU/ml)	4.5% Treatment (CFU/ml)
Day 0	20	<10
Day 2	480	340
Day 4	450	720
Day 6	25,000	7,900
Day 8	5,000,000	3,900,000
Day 10	15,000,000	14,000,000
Day 12	38,000,000	14,000,000
Day 13	120,000,000	6,300,000
Day 14	170,000,000	17,000,000
Day 15	170,000,000	9,800,000
Day 16	260,000,000	25,000,000
Day 18	120,000,000	29,000,000
Day 20	1,200,000,000	14,000,000
Day 22	350,000,000	83,000,000

* CFU/ml: Colony Forming Units per milliliter

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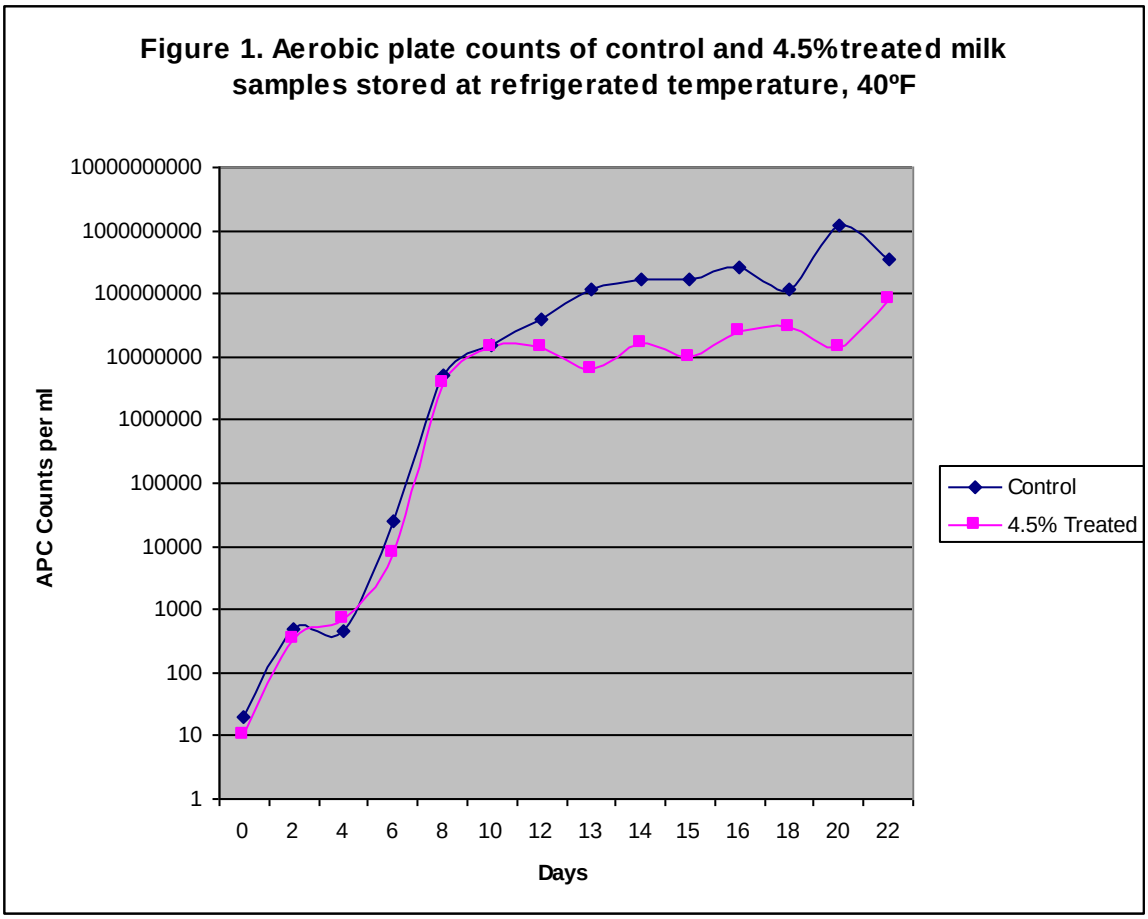

Table 2. Psychrotrophic plate counts (CFU/ml)* of control and 4.5% treated milk samples stored at refrigerated temperature, 40ºF.

Interval	Control (CFU/ml)	4.5% Treatment (CFU/ml)
Day 0	<10	<10
Day 2	<10	<10
Day 4	230	170
Day 6	19,000	3,600
Day 8	7,200,000	3,000,000
Day 10	15,000,000	17,000,000
Day 12	61,000,000	7,400,000
Day 13	280,000,000	120,000,000
Day 14	650,000,000	20,000,000
Day 15	700,000,000	13,000,000
Day 16	1,000,000,000	2,700,000
Day 18	280,000,000	43,000,000
Day 20	3,900,000,000	25,000,000
Day 22	1,200,000,000	83,000,000

* CFU/ml: Colony Forming Units per milliliter

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Figure 2. Psychrotrophic plate count of control and 4.5% treated milk samples stored at refrigerated temperature, 40ºF

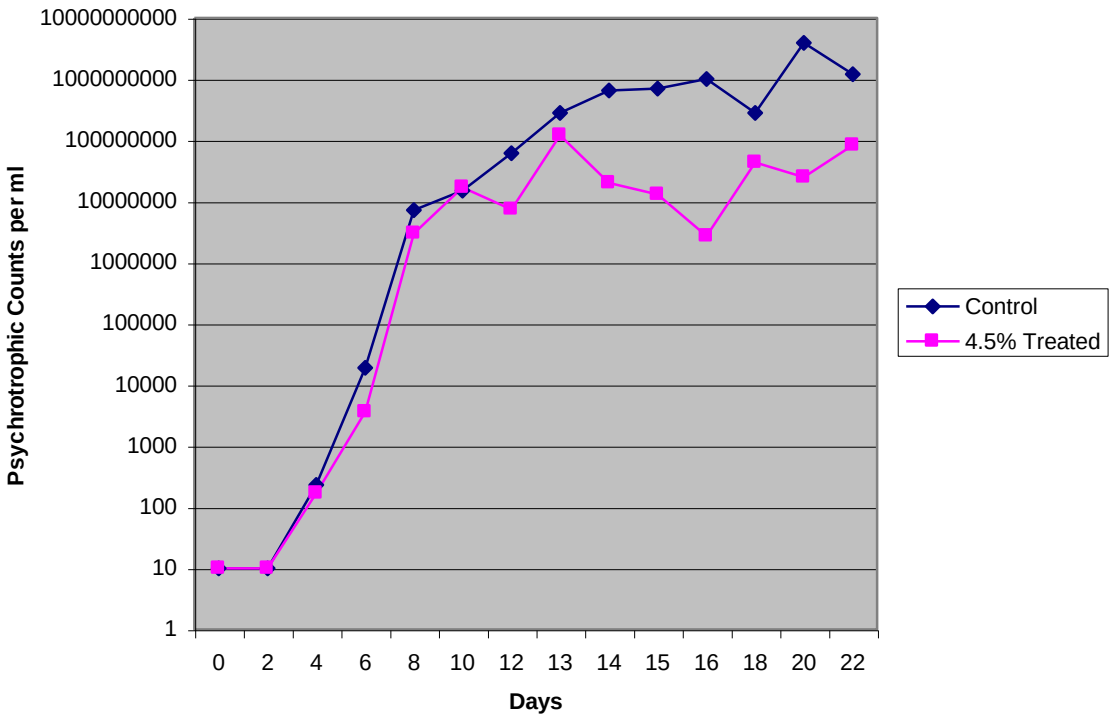

Table 3. pH values of control and 4.5% treated milk samples stored at refrigerated temperature, 40ºF.

Interval	Control	4.5% Treatment
Day 0	6.67	6.69
Day 2	6.71	6.74
Day 4	---	---
Day 6	6.46	6.51
Day 8	6.4	6.53
Day 10	6.4	6.64
Day 12	6.48	6.68
Day 13	6.3	6.66
Day 14	6.09	6.6
Day 15	5.83	6.07
Day 16	5.8	6.53
Day 18	5.41	6.62
Day 20	5.09	6.5
Day 22	5	6.43

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Figure 3. pH values of control and 4.5%treated milk samples stored at refrigerated temperature, 40ºF

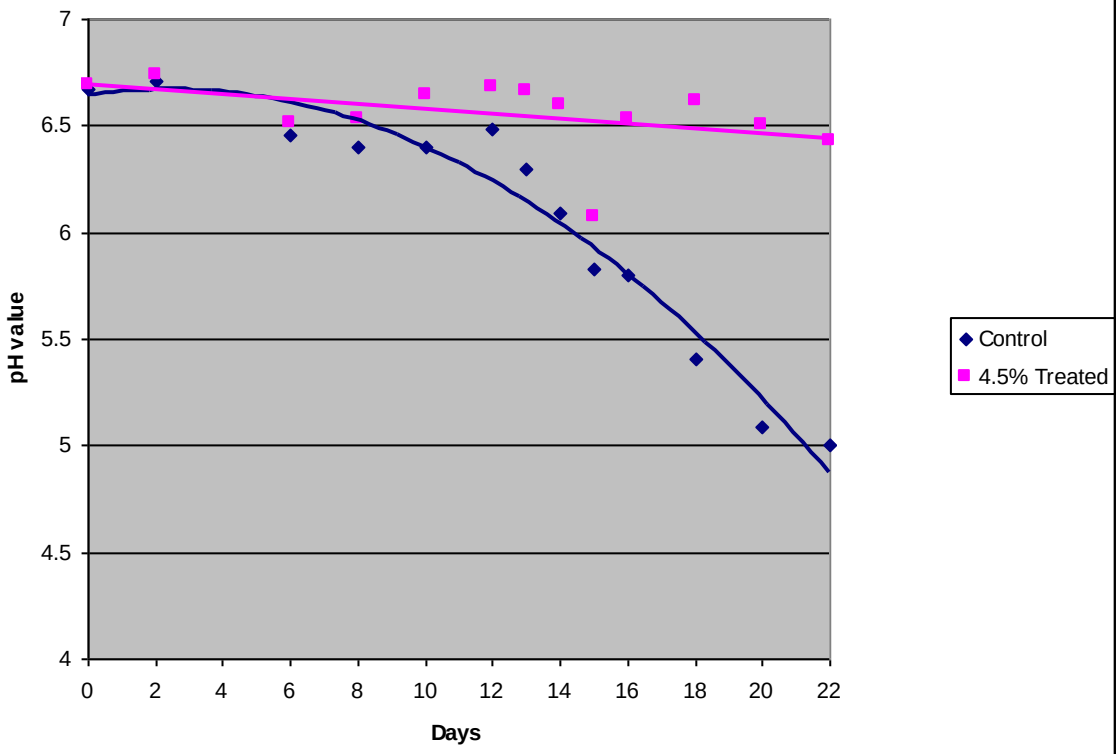

Table 4. Peroxide values of control and 4.5% treated milk samples stored at refrigerated temperature, 40ºF, for 22 days.

	Initial (day 0)	Control (day 22)	4.5% Treated (day 22)
Peroxide Value (meq/kg)	<0.12	0.35	0.13

Meq/kg: Milliequivalent per kilogram

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