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EFFECT OF PASTEURIZATION, BOILING AND STERILIZATION ON BUFFALO MILK

III—Nitrogen Distribution and the Alcohol Coagulation of Milk

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Pasteurization insignificantly decreases the total nitrogen, non-casein nitrogen and the whey proteins, while it increases the casein nitrogen and non-protein nitrogen of fresh milk. Boiling or sterilization significantly decreases the non-casein nitrogen and the whey proteins of fresh milk. Both treatments however, cause an insignificant increase in the total nitrogen, casein nitrogen and non-protein nitrogen. The increase in total nitrogen, or, casein nitrogen is insignificant between the different treatmentsof Boiling or sterilization of fresh milk significantly increases the amount of precipitated whey proteins relative to their contents in the pasteurized samples. The stability of fresh milk to coagulation by alcohol increases progressively due to pasteurzation, boiling and sterilization.

The two principal areas of interest in the chemistry of heated milk are the changes associated with the milk serum proteins and these related to the browning reaction.

The effect of heat on serum proteins of milk constitutes a very important problem in industry and dairy chemistry. Such heat produced phenomena as cooked flavor, development of reducing properties impairment of milk clotting in soft cheese manufacturing and the inhibition of gelation of evaporated milk on sterilization have all been attributed in whole or in part to effects of heat on milk serum proteins.

Therefore, the object of this investigation was to determine and compare the changes nitrogen contents and the alcohol coagulation test due to pasteurization, boiling and sterilization on fresh buffalo milk. Accordingly, total nitrogen, casein nitrogen, non-casein nitrogen, non-protein nitrogen, whey proteins and precipitated whey proteins were determined. Also, the changes in the qualitative alcohol test were recorded.

Experimental and Method of Analysis

The same number of samples of buffalo milk was obtained and heat treated as presented in (I) in Animal Production Conference (1969).

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Total nitrogen (T.N.) non-casein nitrogen (NCN), and non-protein nitrogen (NPN) were estimated by the semimicro-Kjeldahl method as explained by Ling (1956). Casein nitrogen (CN), and whey proteins (WP) were calculated from the differences between TN and NCN ; and NCN and NPN respectively. Similarly, the precipitated whey protein was determined from the difference between the whey proteins of fresh and heat treated samples.

Alcohol test was determined according to the Standard Methods of Analysis of milk, Laboratory Manual (1949).

Analysis of variance was carried out and the significant differences between mean values were calculated by Duncan's new multiple range test, according to, Steel and Torrie (1960). Ninty five and 99 percent levels of confidence were chosen for all tests of significance.

Results and Discussion

The effect of pasteurization, boiling and sterilization are the nitrogen distribution in fresh milk samples were summarized in table (1) and figure (1). The significance between the mean values of (NCN), WP), and pericipated whey proteins in fresh and heat treated samples is shown in table (2).

The percentage of denaturation of whey proteins after pasteurization, boiling and sterilization relatively to the whey proteins of fresh samples were 6.55, 45.97 and 50.26 per cent respectively.

TABLE 1.—THE MEAN VALUES OF NITROGEN DISTRIBUTION IN FRESH, PASTEURIZED, BOILED AND STERILIZED MILK SAMPLES.

Nitrogen distribution	Fresh	Pasteurized	Boiled	Sterilized
	%	%	%	%
Total nitrogen	3.8043	3.7683	3.8188	3.8342
Casein nitrogen	3.0317	3.0563	3.2950	3.3167
Non casein Nitrogen	0.7729	0.7475	0.5238	0.5188
Non proteins N	0.2323	0.2363	0.2368	0.2462
Whey protein	0.5406	0.5153	0.2922	0.2690
Precipitated whey protein . .	—	0.0354	0.2513	0.2765

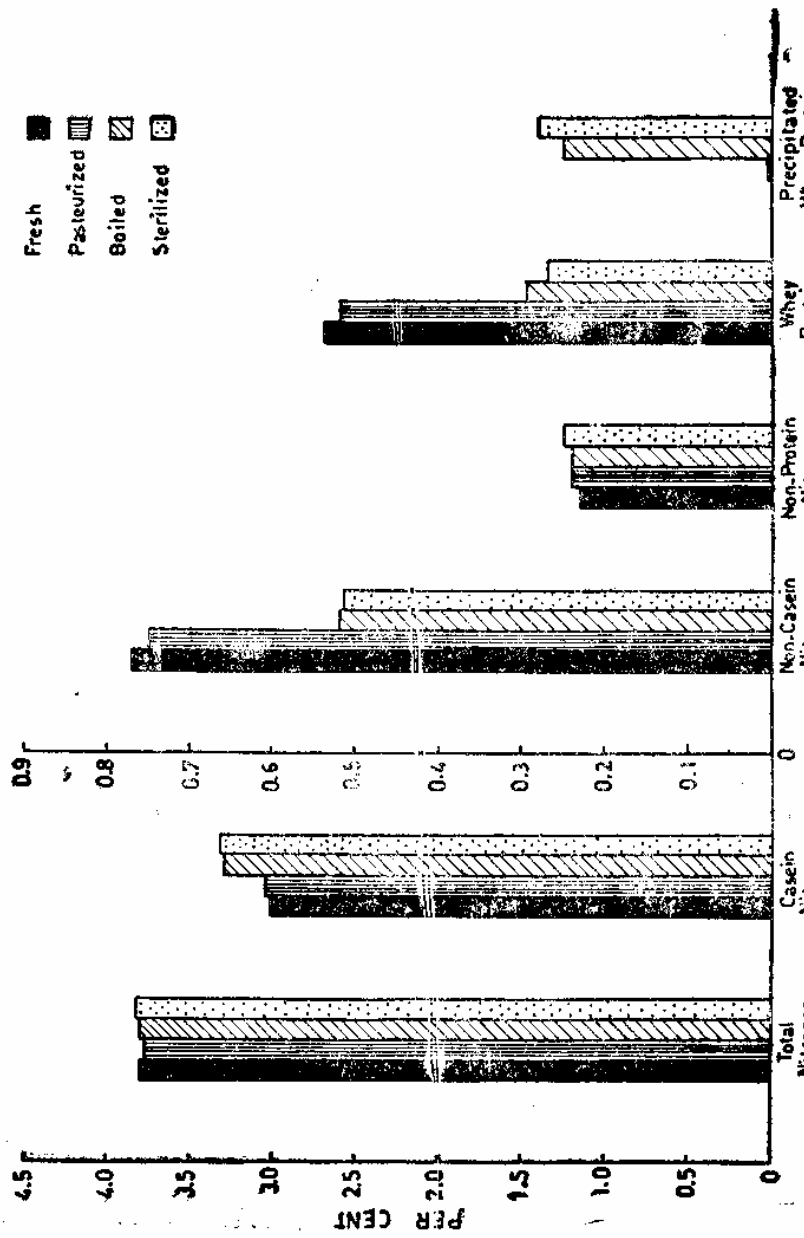

FIG. 1.—The effect of Pasteurization, Boiling and Sterilization on Nitrogen Distribution in the Fresh milk samples.

TABLE 2.—THE SIGNIFICANCE BETWEEN MEAN VALUES OF NON-CASEIN NITROGEN, WHEY PROTEIN AND PRECIPITATED WHEY PROTEIN IN FRESH AND HEAT TREATED SAMPLES.

Difference between	Non-casein nitrogen		Whey protein		Precipitated Whey protein	
	0.05	0.01	0.05	0.01	0.05	0.01
Fresh and ster.	+	+	+	+		
Fresh and boiled	+	+	+	+		
Fresh and past.	—	—	—	—		
Pasteurized and sterilized . . .	+	+	+	+	+	+
Pasteurized and boiled	+	+	+	+	—	—
Boiled and ster.	—	—	—	—	+	+

Ster. = steralized.
\+ = significant.
— = insignificant.

From these results, it was clear that the pasteurization had a slight insignificant effect on the distribution of milk. However boiling and sterilization showed clear progressive changes in its pattern. The principal changes which become evident with increasing heat treatment were an increase in the apparent casein nitrogen with a corresponding decrease in whey protein accompanied by an obvious increase in denaturation. Those changes agreed perfectly with the discussion of Jenness and Patton (1959), who attributed these changes to heat denaturation of the milk serum proteins.

Rowland (1938), observed that about 80 percent of the whey proteins mostly lactoglublins and lactoblumins were denatured by heating over 100°C. The remaining 20 percent were considered the proteose-peptones fraction which often formed by partial hydrolytic degradation of proteins. Furthermore, he (1937) noted that no changes took place in the non-protein nitrogen content of milk on heating at temperatures up to 100°C. Arshinove (1952) and Benassi (1962) stated that the usual pasteurization method did not alter the proteins of milk, however, the rate of coagulation and setting of the casein in rapid pasteurization at 90°C, boiling or autoclaving indicated partial denaturation. Karte (1956) found a marked denaturation of whey proteins even

in the initial pre-heating stage, while sterilization gave a rise to changes which included an increase in the free a-amino nitrogen content of milk. El-Hagarawy (1962) reported that the whey proteins started to decline on heating at 72°C. and the loss increased as the heating progressed. Contrary to the present findings, Rossmann (1949) found that of the numerous analysis carried out gave no changes in composition of boiled if compared to unboiled milk samples.

The test for alcohol stability of the different treatments indicated that 74.83% of the fresh samples 55.17% of the pasteurized, 20.69% of the boiled and 6.9 percent of the sterilized milk samples gave positive test. The stability of fresh milk increased progressively by the raise in the temperature of heat treatment from pasteurization to boiling and finally to sterilization. Agreeing with those results, Webb and Bell (1942) found that the forewarming treatment of milk before condensing increased the stability of the evaporated product during sterilization. Suggestions had been made that milk heat treatment excerted its influence through shifts in the salt equilibria possibly through precipitation of calcium phosphate. It decreased in the solubility as the temperature increased. Denaturation of serum proteins by heat might also increase milk stability. To date, however, a conclusive statement cannot be made as to the mechanism involved as reported by Jenness and Patton (1959)

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تأثير البسترة والغلى والتعقيم على اللبن الجاموسى
٢ ـ التوزيع النتروجينى والتخثر الكحولى للبن

ابراهيم الدسوقى رفعت ـ جمال الدين الصادق ـ فاروق هلال ـ أحمد عبد الغنى

الملخص

تنقص البسترة نسب النيتروجين الكلى ـ والنيتروجن الغير كيزينى وبروتينات الشرش نقصا غير جوهرى بينما يزيد النيتروجين الكيزينى والنيتروجين الغير بروتينى فى اللبن الطازج . الغليان أو التعقيم ينقصان جوهريا نسب النيتروجين الغير كيزينى وبروتينات الشرش فى اللبن الطازج وكلتا المعاملتين تسببان زيادة غير جوهرية فى النيتروجين الكلى والنيتروجين الكيزينى والنيتروجين الغير بروتينى كما أن الزيادة فى النيتروجين الكلى أو الكيزينى غير جوهرية فى مختلف المعاملات .

يزيد الغليان أو التعقيم كمية بروتينات الشرش المترسبة بالنسبة لكميتها فى العينات المبسترة ـ درجة ثبات اللبن الطازج بالنسبة للتخثر بالكحول تزيد زيادة مضطردة نتيجة البسترة ـ والغلى ـ والتعقيم .