J. Anim. Prod. U.A.R., 9, No. 1, pp. 93-99 (1969).

EFFECT OF ADULTRATION OF MILK BY THE ADDITION OF WATER ON SOME QUALITY CONTROL TESTS

A. H. Fahmi*, G. Abd-El-Tawab **
and A. Abou El Heba

In this study the effect of dilution on the specific gravity of milk, clot on boiling and the alcohol est was investigated. The results obtained substantiate the previous findings of the higher sensitivity of the alcohol test as affected by developed acidity. To obtain more reliable results for the freshness and keeping quality of milk, carrying out both tests is recommended.

Since titratable acidity is decreased by dilution, testing for acidity alone may give misleading results.

Milk is one of the most commonly adultrated foods, in this country. This fact is substantiated from the results reported by Sadek and Hamed (1957) and Abd-El-Tawab *et al.* (1961) the trend of which still exists.

Adultration of milk may lead to:

1. Health hazards,

2. Lowering the nutritive value of milk & its products,

3. technological difficulties in the processing of milk and manufacture of dairy products,

4. nullifying the result of test carried out for the evaluation of the quality of milk depending on method of adultration practiced.

Although these adverse effects of adultration are established, information regarding the last of these effects wes considered rather scanty and in need of further verifying studies. Of the more common ways of adultrating milk, dilution with water takes the lead and thus was depicted for this study. The points investigated were the effect of dilution on specific gravity (Sp. Gr.) titratable acidity (T.A.), alcohol precipitation test (A.P.T.) and clot on boiling (C.O.B.).

Materials and Methods

The milk used in this study was obtained from the herd of the Faculty of Agriculture, Cairo University, Tests carried out were according to Chalmers (1962) and Abd-El-Tawab & Hadmy (1967).

* Faculty of Agriculture, Cairo University.

** Faculty of Agriculture El-Azhar University.

Results and Discussion

SECTION 1.—*Effect of Dilution of Milk in Specific Gravity*

Samples of milk were diluted with varying quantities of water then tested for specific gravity (Sp. Gr.) at 60°C by means of a calibrated lactometer.

Results shown in Graph 1 indicate a decrease in specific gravity. This decrease was sharp with the lower dilutions, then the rate or decrease became less with greater dilutions. Calculation, however, shows that specific gravity of diluted milk was more or less the sum total of the mixture resulting from added water to milk. For example adding 50 ml. of water to 100 ml. of milk with a (Sp. Gr.) of 1.033 would by calculation result in mixture with a sp. gr. of $\frac{50\times1 + (100\times1.033)}{50 + 100} = 1.022.$

SECTION 2.—*Effect of dilution of milk in titratable acidity, clot-on-boiling and alcohol precipitation test*

Initial T.A. of milk expresses calculate acidity percent. This percentage depends upon the concentration of the acidic milk constituents namely: the proteins, acid phosphates and citrates an dissolved carbon dioxide. Dilution with water decreases the concentration of these constituents and leads to the change of some acid calcium phosphate to the tricalcium form. Thus acidity percent decreases.

Developed acidity is caused by the fermentation of milk by acid producing bacteria mainly on lactose. Total acidity means initial plus developed acidity.

C.O.B. may occur as a result of the effect of heat on milk proteins by dehydration, denaturation and the upset of the salt balance.

As acidity rises in milk, an increase in the hydrogen ions occurs. By neutralizing the charges on the protein molcules and increasing the upset in the salt balance an additive factor comes into play enhancing the effect of heat in the coagulation of milk proteins. Precipitation of proteins by ethyl alcohol is due to the dehydrating effect of the alcohol on the proteins anhanced by its upsetting effect in the salt balance in the milk system. With the alcohol test, increased acidity also exerts similar effect to those mentioned in clot on boiling.

Tables 1,2 and 3 give the average of results obtained from then experiments with these three tests.

The results obtained indicate:

1. The initial T.A. of buffaloe's milk was by 0.02% higher than cow's milk. Such a result may be considered rather unusual as the average acidity of cow's milk that has been reviewed and reported by Ahmed (1960) was greater than buffaloes.

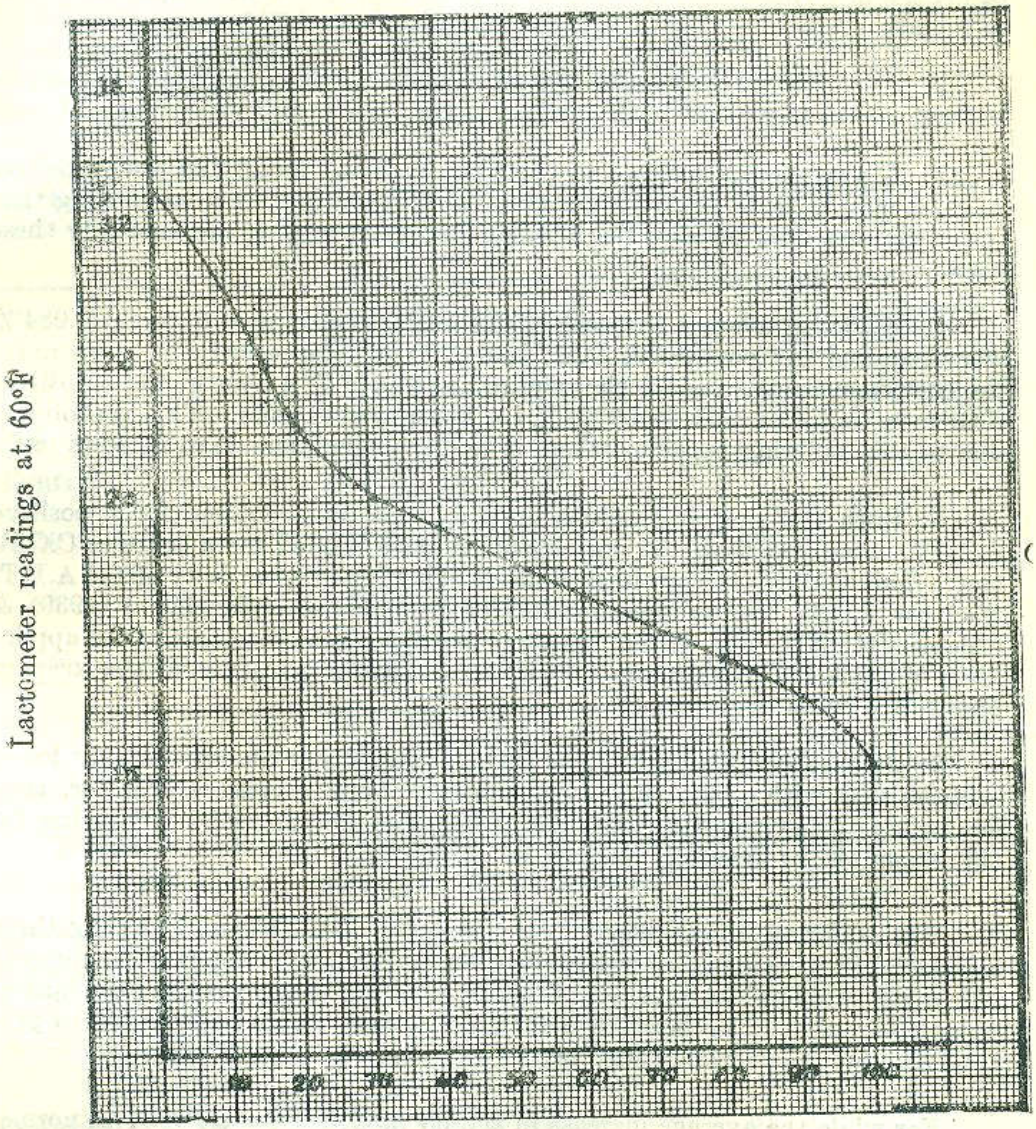

FIG. 1—Effect of dilution on lactometer readings

The presented results obtained by the writers, however, may be due to the limited number of buffaloes from which the samples of milk were taken. Those Buffaloes which were only four in number were also at their late stage of lactation. These conditions seem to have resulted in all samples of buffaloe's milk giving a positive alcohol precipitation test.

2. As expected, the greater the amount of water added, the less was the percent of acidity with both buffaloe's and cow's milk.

3. A progressive increase in the time required for giving both positive A.P.T. and C.O.B. results took place as dilution increased, indicating that water dilution does prolong the keeping quality of milk as measured by these tests.

4. While an average increase of the initial acidity by 0.025 and 0.084% were required for positive A.P.T. and C.O.B. respectively in cows milk, the corresponding figures for the require increase in T.A. for giving a positive C.O.B. in buffaloes milk was 0.07% i.e. lower than in cows. This is probably due to the buffering capacity which is higher in buffaloes than in cows milk.

5. Both the average increase in T.A. and time required for a positive A.P.T. were less than the corresponding ones needed for a positive C.O.B. test. This confirms the established result of the higher sensitivity of the A.P.T. than the C.O.B. test as measures for the fershness of milk, Davies (1939) & Chlamers (1962). The writers therefore are inclined to recommend the application of the A.P.T. besides the C.O.B. for the better prediction of the keeping quality of milk.

6. Since a positive A.P.T. or C.O.B. may occur at considerably lower acidities than with normal milk, as in the case of milk diluted with water, testing for the acidity percent should not be taken as the sole reliable measure for the freshness or keeping quality of milk.

With dilution, the percent of all the milk constituents including those responsible for the initial as well as the developed acidity decrease in proportion to the extent of dilution. As dilution seems to favour lowering the buffering capacity of milk, the increase in developed acidity would be expected to proceed and did so at a relatively higher rate than in normal milk.

For while the average increase in acidity at C.O.B. was 0.084 in normal milk , the corresponding value for 50% dilution was 0.065 equivalent to 77% total of normal milk i.e. greater than the proportioned 50% dilution. This result would mean that by dilution:

(*a*) A relatively greater increase in T.A. in proportion to the amount of casein has to be reached before C.O.B. or A.P. takes place.

(*b*) A relatively longer time is required for positive results with C.O.B. or alcohol precipitation.

The explanation of these phenomena may be based upon the law of mass action where the rate of chemical reactions depends upon the concentration of reacting substances.

Since the concentration of both milk proteins and acidity is decreased by dilution and according to the law of mass action longer time is thus needed for the increase of the acidity to the level required for the coagulation of dispersed milk proteins.

TABLE 1.—EFFECT OF DILUTION ON ACIDITY LEVEL REQUIRED FOR ALCOHOL PRECIPITATION IN COWS' MILK

Water % in diluted Milk	Acidity at Start %	Acidity at A.P. %	Developed Acidity %	Age of sample at A.P.		Increase in time due to dilution	
				hr.	min.	hr.	min.
Control	0.16	0.185	0.25	4	24	—	—
10	0.146	0.170	0.24	4	54	—	30
30	0.109	0.132	0.23	5	33	1	9
50	0.08	0.095	0.010	6	—	1	36

TABLE 2.—EFFECT OF DILUTION ON ACIDITY LEVEL REQUIRED FOR C.O.B. IN COW'S MILK

Water % in diluted Milk	Acidity at Start %	Acidity at C.O.B. %	Developed Acidity %	Age of sample at C.O.B.		Increase in time due to dilution	
				hr.	min.	hr.	min.
Control	0.16	0.244	0.84	5	57	—	—
10	0.146	0.220	0.74	6	23	—	26
30	0.109	0.176	0.67	6	47	—	50
50	0.08	0.145	0.65	7	18	1	21

TABLE 2.—EFFECT OF DILUTION ON ACIDITY LEVEL REQUIRED FOR C.O.B. IN BUFFALOE'S MILK

Water % in diluted milk	Acidity at Start %	Acidity at C.O.B. %	Developed Acidity %	Age of Sample at C.O.B.		Increase in time due to dilution	
				hr.	min.	hr.	min.
Control	0.18	0.25	0.07	4	46	—	—
10	0.16	0.22	0.06	5	7	—	21
30	0.12	0.18	0.06	5	10	—	24
50	0.09	0.14	0.05	5	25	—	39

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تأثير غش اللبن بالمـاء على بعض الاختبارات الخاصة بتحديد درجة جودته

الدكتور على حسن فهمى ـ الدكتور جمال الدين عبد التواب ـ السيد/أحمد ابو الهيبه

الملخص

درس فى هذا البحث تأثير غش اللبن بالمـاء على نتائج بعض اختبارات الرقابة العملية وهى الوزن النوعى واختبـارى التجبن بالفليان والتجبن بالكحول .

وقد اظهرت النتائج زيادة حساسية اختبار الكحول عن الفليان عنـد ارتفاع الحموضة ، كما تبين أيضا خطأ الاعتماد على تقدير حموضة التعادل فقط للحكم على طزاجة اللبن نظرا لانخفاض نسبتها بالتجفيف . ولهذا ينصح الباحثون باجراء كل من اختبارى التجبن والكحول والتجبن بالفليان للحصول على معلومات أصح عند استلام اللبن .