CHEESE YIELD INVESTIGATIONS: THE SAMPLING OF CHEESE MILK.

By V. R. SMYTHE, M.Sc.Agr. (Senior Bacteriologist), and N. B. STANTON, B.Sc., A.R.A.C.I (Analyst), Dairy Research Laboratory.

SUMMARY.

Some methods of sampling cheese milk, including those commonly used in Queensland, were examined. The results obtained by these methods have been compared with those obtained by using an experimental sampler designed and made for the purpose. The fat content of a series of samples has been taken as the criterion of sampling efficiency.

Multiple samples at all levels on each side of the vat were used to provide a "fat standard" for each vat. The experimental sampler gave results which agreed most closely with the standard, but a sample composed of 12 equal quantities of milk from 12 positions on the surface of the vat, six from each side, also gave a good result. In normal factory practice starter is added to the vat and a correction for this must be made to the result given by the experimental sample.

A "drip" sample obtained in a bucket hung under a loosened pipe joint gave a very unreliable sample.

The construction of the experimental sampler is outlined.

I. INTRODUCTION.

In the course of investigations into the cheese-yielding capacity of milk the need has arisen for an accurate sample of the milk entering any particular cheese vat. Without such a sample any work done along the lines of milk composition and cheese yields is rendered worthless. Veale (1929) and McDowall (1936) earlier gave attention to this matter.

In this paper are presented the results of an enquiry into some methods of sampling, together with the results obtained with a new sampling apparatus.

Methods previously employed in this State for the sampling of bulk cheese milk have included:—

(1) Taking a dipperful of milk from one or more points on the surface of the vat.

(2) Drip sampling from a loosened nut in the milk pipe-line.

(3) Drip sampling from a hole in the milk pipe or flue leading to the cheese vat.

The two drip samples appear to suffer from the disadvantage that the rate of flow of milk as a sample is inconsistent with the rate of flow of the bulk of the milk. Milk lying in the pipe or flue when flow ceases runs through the loose nut or hole and becomes part of the sample. In the case of a horizontal milk line a large part of the sample may consist of milk lying in the pipe during

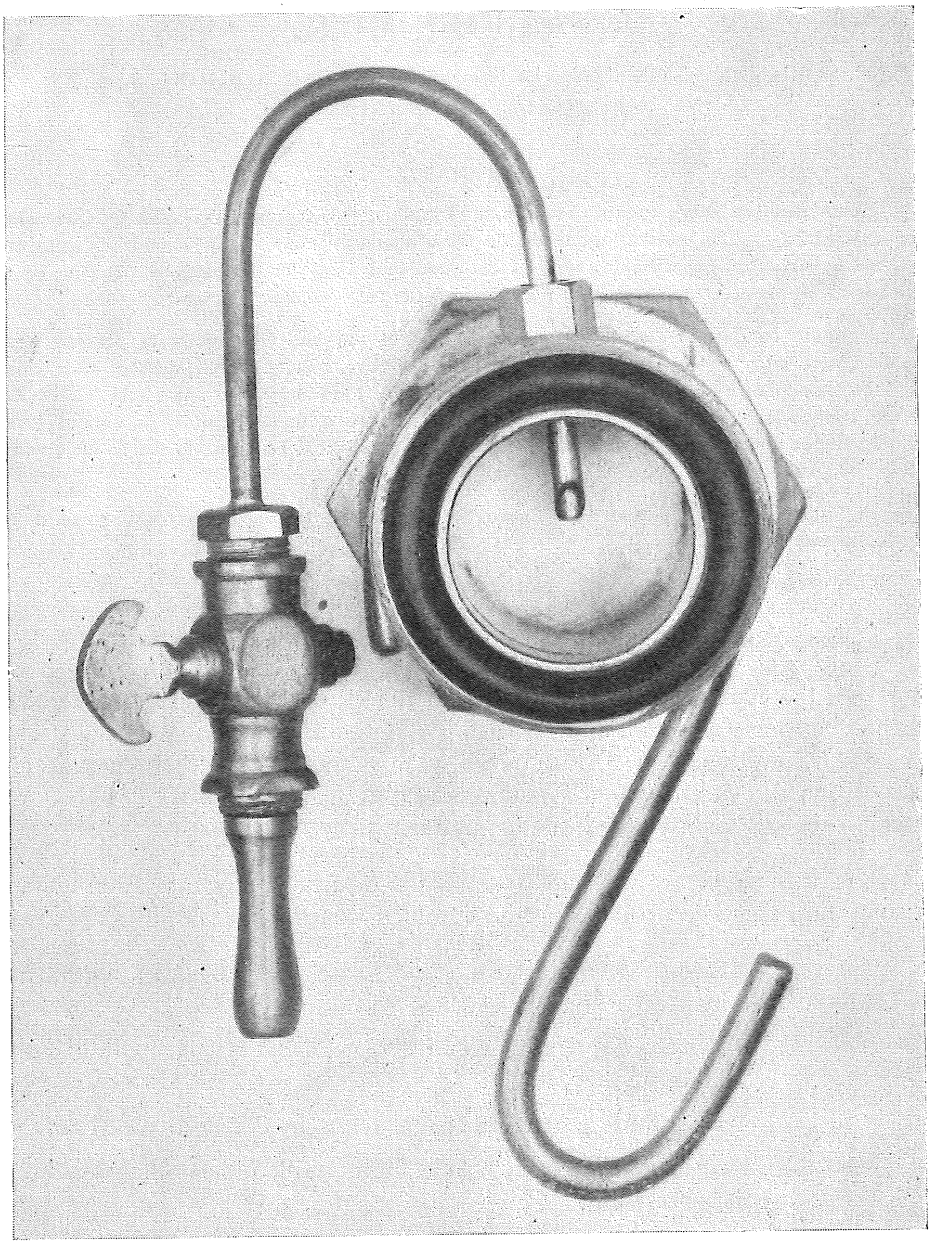

Fig. 1.

End View of Experimental In-line Sampler.

periods of pasteurizer shut-down. Observations have shown that the loosened nut is open to a further objection in that the rate of sampling fluctuates greatly even during a continuous run.

It was obvious that a method of sampling was required which would give a constant rate of sampling dependent on pumping rate and which did not have to be continually watched.

II. METHODS.

In normal cheese factory practice, starter is added to the milk in the vat prior to the vat becoming full. Thus a sample of the milk in the vat when full will contain starter, which is usually skim-milk and which will cause a slight but significant lowering of the fat content (approx. 0·1 per cent.). For our purpose where samples have to be transported to the laboratory for detailed analysis, the presence of starter is objectionable for a further reason in that the acidity, which develops rapidly, becomes a hazard. Consequently, it was necessary to devise some means of accurately sampling the milk prior to its entering the vat.

In order to fulfil this purpose the sampling device shown in Figs. 1 and 2 was constructed. Primarily, it consists of a short coupling of $1\frac{1}{2}$ in. stainless steel which can be attached at any union of the milk pipe-line from the pasteurizer to the vat. Through the upper wall of the coupling a metal tube of $\frac{1}{8}$ in. bore projects downward into the lumen of the pipe. The end of this tube is truncated so that the tube opening faces into the milk flow and the height of the tube can be adjusted to the approximate centre of the pipe-line. Attached to the other end of the tube is a small cock which enables the sampling rate to be adjusted. A simple hook hangs from the sampler to hold the sample container—usually a bucket. The whole apparatus can be dismantled for cleaning and can be sterilized before use.

In practice, no flow of milk can be obtained from this sampler unless the milk pump is operating and creating sufficient milk pressure to force milk up the curved tube. When the pump is switched off, the milk level in the line almost immediately falls below the truncated end of the sampling tube and no sampling occurs. Thus milk which is residual in a line after the pump has been switched off does not continue to be sampled.

(1) Testing of Sampler.

In testing this sampling device the fat content of the sample was used as the criterion of sampling accuracy, to which use it would appear to be pre-eminently suited. The need arose, however, for obtaining a standard fat assessment against which that obtained from the sampler could be judged. Such a standard was obtained in the following manner.

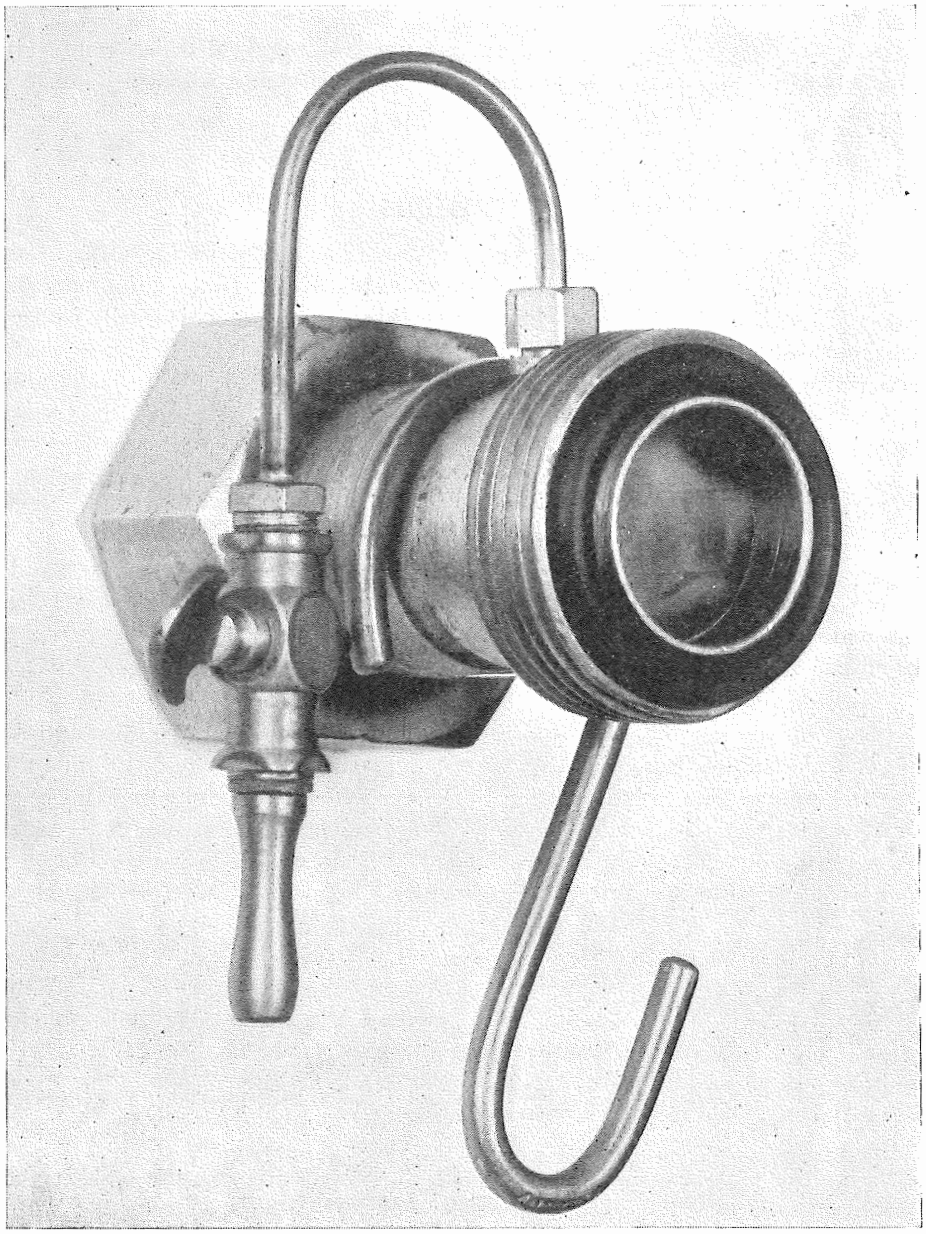

Fig. 2.

Side View of Experimental In-line Sampler.

The vat stirrers were set in motion during the whole time milk was entering the vat and were kept in motion until sampling ceased. One minute after the vat was full, six samples were taken, viz.,

(1) A dipperful was taken from each of six positions along the surface of the vat along one side.

(2) Same as (1) along the other side.

(3) A stainless-steel sampling tube capable of reaching the bottom of the vat was used. The height of milk at the side of the vat was measured, and at half this distance from the bottom of the tube a metal band $\frac{3}{8}$ in. wide was fixed in place by means of a milled-head screw. The thumb was placed over the end of the tube, the tube immersed to the point of the metal band, and the thumb released for a few seconds to allow the level of the milk in the tube to become steady. The thumb was then placed over the end of the tube again, the tube withdrawn from the vat, and the milk so removed allowed to run into a bottle. This procedure was followed for six positions along one side of the vat.

(4) Sampling as in (3) was repeated for the other side of the vat.

(5) The sampling tube was immersed to the full depth of the milk, using the same procedure for removing the sample as was adopted in taking sample 3. Again, milk was taken from six positions along one side of the vat.

(6) The above (sample 5) was repeated for the other side of the vat.

In order to standardise techniques, in every run of this experiment one of us took samples 1 and 2 while the other took samples 3, 4, 5 and 6.

The fat content of each of the six samples above was measured in quadruplicate. The mean of all 24 estimations thus obtained, calculated to the second place of decimals, has been used as the standard fat content of the vat.

(2) Examination of Other Sampling Methods.

For purposes of comparing samples obtained by means of the experimental sampler with those taken by other methods, two additional samples were taken for each vat examined, viz.,

(1) One was taken from the same pipe-line as the experimental sampler, and in a position adjacent to but nearer to the vat. A nut was loosened in the line to provide a drip sample.

(2) With the stirrers still in motion, a dipperful of milk was taken at each of 12 positions from the surface of the vat. For convenience, this sample is termed the field sample.

For all three samples (experimental sampler, drip and field), fat estimations were performed in eight replications and the means calculated to two places of decimals.

During each factory visit two vats of milk were examined. In some vats no starter was added until all sampling was completed; in others, starter was added in the normal way. When starter was added corrections were made from a knowledge of the weight of milk in the vat and weight of skim-milk, as starter, added to allow for the difference this would make to the fat determination of the standard and of the field sample. When taking cheese yields into account, the correction of course has to be made in the opposite way, and the analysis of a sample of milk before the addition of starter has to be corrected for this starter when considering the yield of cheese of a particular vat.

All fat determinations were made by the Babcock method, giving readings to 0·1 per cent. In this testing the same 17·6 ml. pipette was used throughout. The operations of pipetting the samples, adding the acid, etc., were standardised so that the same worker carried out the same operations on every sub-sample. This was rigidly adhered to so that variations due to differences in techniques of different workers would be eliminated.

III. RESULTS AND DISCUSSION.

In all, 10 vats were examined, six at Factory A and four at Factory B. A variation of 0·3 per cent. fat between eight replicate Babcock tests occurred only once. A variation of 0·2 per cent. fat between similar replications was not uncommon. Such a variation between replicate fat tests is of some importance in view of the precautions which were taken to standardise techniques in Babcock testing. Thus it would appear necessary in all cheese yield work to perform the fat tests at least in quadruplicate in order to minimise error from this source. McDowall (1936) drew attention to the variation in the apparent yield of cheese which results from an error of $\pm$ 0·1 per cent. (0·2 per cent. variation) in the fat test. The results as means are summarised in Table 1.

The divergence of the value for the experimental sampler from the standard varied from 0·01 per cent. to 0·06 per cent., the mean being 0·03 per cent. (S.D. $= \pm$ 0·028). This must be considered very satisfactory.

The divergence of the value for the field sample from the standard varied from 0·01 to 0·09 per cent., the average being 0·05 per cent. (S.D. $= \pm$ 0·039). This must be considered fairly satisfactory and entirely adequate for the needs of routine vat testing by the factories themselves.

Table 1.

COMPARISON OF SAMPLING METHODS.

Factory.	Date.	Vat No.	Starter Added.	Fat Percentage.			
				Vat Standard.	Experimental Sampler.	Drip Sample.	Field Sample.
A	29–9–54	1	+	3·92	3·95	3·90	3·90
		2	—	4·14	4·10	4·25	4·23
	27–10–54	1	—	4·20	4·16	4·13	4·19
		2	+	4·11	4·05	4·11	4·08
	17–11–54	1	—	4·06	4·04	4·05	4·10
		2	+	4·09	4·11	4·38	4·13
B	9–12–54	1	+	4·27	4·26	4·30	4·24
		2	+	4·11	4·08	3·91	4·09
	14–12–54	1	—	3·94	3·91	3·96	3·95
		2	—	4·04	4·03	4·06	4·03

+ = Starter added and correction made.
— = Sampled before starter added.

The divergence of the value for the drip sample from the standard varied from 0·00 to 0·29 per cent., including values of 0·11 per cent. and 0·20 per cent. The average was 0·08 per cent. (S.D. $= \pm 0 \cdot 125$). This result would indicate that this method of sampling is unreliable, and its use is to be discouraged.

The results obtained were also examined in order to discern any differences in fat percentages in milk from different levels in the vats and from different sides of the vat. The mean values for 10 vats were as follows:—

Table 2.

Sample.	Mean Fat Percentage (10 Vats).
Surface, south side	4·01
Surface, north side	4·02
Middle, south side	4·035
Middle, north side	4·00
Bottom, south side	4·08
Bottom, north side	4·045

It is apparent from these results that there was no pattern of difference in fat percentage between the top, middle and bottom layers of milk, or in the milk from either side of the vat. The only conclusion possible from this finding is that the agitators, being in motion for the whole time the vats were filling with milk, provide very thorough mixing.

IV. ACKNOWLEDGEMENTS.

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