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DEPARTMENT OF AGRICULTURE  
OFFICE OF THE DAIRY COMMISSIONER.

OTTAWA, February 19, 1917.

## FURTHER NOTES

ON

### THE USE OF PEPSIN AND OTHER SUBSTITUTES FOR RENNET IN THE MANUFACTURE OF CHEESE.

Early last year it became evident that there would be an actual shortage of rennet extract in Canada before the season was very far advanced.

To meet the situation members of the Dairy Commissioner's staff at once began experimenting with substitutes, at the Finch Dairy Station. Several lots of cheese were made by adding to the milk, along with standard rennet extract, a 10 per cent solution of hydrochloric acid, at the rate of  $5\frac{1}{2}$  ounces per 1,000 pounds of milk, and using only half the usual quantity ( $1\frac{1}{2}$  ounces) of rennet. Fairly good cheese were made with this mixture. The texture, body and colour were about equal to the cheese made from the same lot of milk in which rennet extract only was used. The flavour, however, was very much inferior on account of the strong hydrochloric taint. This acid flavour was still quite pronounced when the cheese were seven months old.

Pepsin was used with much better results. Between May 23 and June 2, five experiments were made, dividing the milk into two lots, using Armour's Soluble Powdered Pepsin in one and Hansen's Rennet Extract in the other lot. Two drams of pepsin and three ounces of rennet extract were used per 1,000 pounds of milk. The curds were handled as nearly alike as possible.

On June 7 the cheese were examined carefully by the following experts: Professor H. H. Dean, Ontario Agricultural College, Guelph, Ont.; Frank Hearn, Chief Dairy Instructor for Western Ontario; G. G. Publow, Chief Dairy Instructor for Eastern Ontario; L. A. Zufelt, Superintendent Eastern Dairy School, Kingston, Ont.; E. Bourbeau, Chief Cheese Instructor for the province of Quebec, and George Hodge, representing the Produce Merchants' Association, Montreal. The authors and Mr. J. F. Singleton, Inspector of Dairy Products, were also present. The opinion was unanimously expressed that from a commercial standpoint there was no difference in the quality of cheese made with pepsin as compared with those made with rennet extract.

These cheese were kept in the cool curing room at the Finch Dairy Station all summer at a temperature of 60 degrees. They were examined by the junior author once every six weeks. On August 22 they were examined by John L. Sammis, Professor of Dairy Husbandry, Madison, Wis. His judgment was that there was practically no difference in the quality of the different lots.

In no case has the flavour of the cheese made with the pepsin been inferior to that of cheese made with rennet. These experimental cheese are now nine months old and our judgment is that the pepsin cheese are still equally as good in texture, and slightly better in flavour than those made with rennet extract. Some of these cheese were shown at the dairy conventions, in Ontario, in January last.



So convinced were we early in the season that pepsin was a safe substitute for rennet that from the 1st of July until the end of the season the only coagulant used at the Finch Dairy Station, except in an experimental way, was Armour's Soluble Powdered Pepsin. This brand was not used because it was believed to have any great superiority over others, but because the department had secured a large supply of it to be distributed among cheese factories at cost in case of actual shortage.

The quality of the cheese made during the season at Finch was such that a premium of from one-sixteenth to one-quarter of a cent per pound was received for them in the open market.

It has been stated that cheese made with pepsin will not keep their flavour, and also that the texture would go wrong as the cheese ripened. So far as our experience goes, there is no foundation for these claims. If such defects are found in cheese made with pepsin, they are due to the condition of the milk, or to wrong methods of manufacture, and not to the use of pepsin.

We feel justified, therefore, in making the statement that as good cheese can be made with pepsin as with rennet extract.

The suitability of pepsin having been demonstrated, our chief concern was to see that the right kind of pepsin was used. During the season we found nine different brands of pepsin being offered for sale and in addition to these, six brands of liquid coagulants, making fifteen in all. Cheesemakers were warned not to use any pepsin or other coagulant until it had been thoroughly tried in a practical way by some competent authority, and it was announced that the Finch Station was prepared to test all samples that might be submitted.

No vendor was encouraged, or assisted in any way, to put his goods on the market before we had given them a fair trial. We felt it to be our duty to protect the cheesemakers from imposition in this matter. The vendors, or would-be vendors, did not always realize their responsibility, or the danger of supplying an article of unknown quality.

The different samples of pepsin received at Finch all gave good results when the proper quantities were used, but there was a wide variation in the strength of the different brands.

We regret that we are unable to report very favourably on some samples of Canadian-made rennet extract received during the past season. They were defective in flavour and not reliable as to curdling properties. We have some cheese on hand made with Canadian rennet extract which have gone wrong in flavour, while those made with Hansen's rennet extract from the same lot of milk are still good in flavour. This is to be regretted, as it is desirable to encourage the manufacture of rennet extract in Canada. No doubt these defects will be overcome as the manufacturers gain experience.

Late in the season samples of the following liquid coagulants were received and tested:—

*Neco Malt*, a solution sold by the National Enzyme Co., Inc., Clifton, New Jersey. Very poor results were obtained from its use. The firm has, however, forwarded another sample which has not yet been tried.

*Hansen's R-P Extract*, made by Chr. Hansen's Laboratories, Little Falls, N.Y., said to be a mixture of half rennet extract and half pepsin, gave excellent results.

*Curdalac* (a pepsin extract), manufactured by Parke, Davis & Co., Walkerville, Ont., gave equally good results as far as the quality of the cheese was concerned, as Standard Rennet extract, or any of the brands of pepsin with which it has been compared. Cheese made with Curdalac were exhibited at the dairy conventions in January.

The following table shows:—

(a) The pounds of milk coagulated fit for "cutting" in 27.5 minutes using definite quantities of the coagulants, and (b) the relative value of the coagulants, taking Armour's Soluble Powdered Pepsin as a basis at \$4.10 per pound:—

Coagulant and Manufacturer or Agent.	Quantity.	Milk Coagulated. Lb.	Relative Value. \$ 10 per lb.
"Soluble Powdered Pepsin"— Armour & Co., Chicago, Ill. . . . .	1 lb.	37,864	\$4 10 per lb.
"Renzyme"— T. E. O'Reilly, Ltd., Toronto, Ont.	1 "	83,333	8 54 "
"Granulated Pepsin"— American Pepsin Co., Madison, Wis. . . . .	1 "	73,242	7 93 "
"Scale Pepsin"— The Bennett & Messecar Co., Ltd., Mille Roches, Ont. . . . .	1 "	47,996	5 19 "
"Scale Pepsin"— Frederick Stearns & Co., Wind- sor, Ont. . . . .	1 "	57,515	6 22 "
"Granulated Pepsin"— National Drug & Chemical Co., Montreal, Que. . . . .	1 "	31,497	3 41 "
"Spongy Pepsin"— Parke, Davis & Co., Walkerville, Ont. . . . .	1 "	25,142	2 72 "
"Rennet Extract"— Chr. Hansen's Laboratory, Inc., Little Falls, N.Y. . . . .	1 gal.	36,666	3 97 per gal.
"R-P. Extract"— Chr. Hansen's Laboratory, Inc., Little Falls, N.Y. . . . .	1 "	34,378	3 72 "
"Curdalac"— Parke, Davis & Co., Walkerville, Ont. . . . .	1 "	36,666	3 97 "

It is a disadvantage to have so many different brands of varying strength on the market, and it is highly important that the different preparations of pepsin should be standardized as to coagulating strength without delay.

It would appear from our experiments, and those of others, that there is a greater loss of fat in the whey, as a rule, when pepsin is used than there is when the milk is coagulated with rennet. We have not been able to determine why this extra loss occurs. Our records show that although the average loss was greater with pepsin there were some cases in which the loss was practically the same as when rennet was used. Further experiments will be carried out in order to discover if possible how this extra loss of fat may be avoided.

The following table shows the average loss of fat with different coagulants:—

Coagulant.	Number of Tests.*	Average Loss of Fat. Per cent.
Pepsin (various) . . . . .	15	0.314
Hansen's Rennet Extract . . . . .	4	0.245
Hansen's R-P. Extract . . . . .	3	0.286
Curdalac (liquid pepsin) . . . . .	5	0.318

\* Tests were made in October and November when some of the milk was being delivered to the factory every other day.

## GENERAL NOTES.

In making cheese with pepsin, the following points should be noted:—

(1) There is a great variation in the strength of the different brands, and care must be taken in testing the strength. The "tea cup" test will not give a true indication of the curdling strength of a pepsin solution if compared with rennet extract. For instance, 1 c.c. of rennet extract in 6 ounces of milk curdled it in forty seconds, while the same quantities of milk and pepsin solution curdled in sixteen seconds, but when two vats of milk were set with the same quantity of each solution, the curds

were ready to cut in the same time. The "tea cup" test is, however, a safe guide as to the relative strength of different pepsin solutions.

(2) Preparing the pepsin for use is somewhat inconvenient. The practice followed at the Finch Dairy Station was to prepare the solution the previous evening by dissolving the quantity of pepsin required for the following day at the rate of 2 drams of pepsin to 3 ounces of water. This is a good safe practice during the summer months. Some cheesemakers have adopted the plan of dissolving 1 pound of pepsin in 10 pounds of water and adding salt as a preservative. If this is done, distilled water should be used and the solution kept in a cool place. We think it safer to make up the solution daily.

(3) Curds made with pepsin should be salted about one-eighth of a pound less than if rennet extract were used (all other conditions being equal). Enough pepsin should be used to coagulate the curd ready to cut in about twenty-five minutes. The longer the time between setting and cutting the greater the loss of fat.

(4) An inquiry sent out revealed the fact that there were at least 402 factories in Ontario and Quebec using pepsin for the greater part of the season of 1916, and that 440 other factories used a mixture of pepsin and rennet.

(5) The fact that so large a number of factories were using pepsin in a season when it is claimed that our cheese was never finer in quality is additional proof of the suitability of pepsin as a substitute for rennet.

(6) With regard to the cost of pepsin, we find that factories have paid from \$3 to \$7.25 per pound. An inquiry as to prices paid for rennet extract shows that factories were charged all the way from \$3.10 per gallon to \$16 per gallon.

The Department of Agriculture has on hand a quantity of Armour's Soluble Powdered Pepsin in one-pound tins, which will be supplied to cheesemakers at actual cost (\$4.10 per pound) on requisition to the Dairy Commissioner, in quantities not to exceed five pounds at one time, and only in cases where the cheesemakers are having difficulty in securing other supply. The department is not in the business of selling pepsin, but it has been thought advisable to keep a quantity on hand as a safeguard in cases of actual shortage.

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