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ЕВРОПЕЙСКИЙ КОНГРЕСС РАБОТНИКОВ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИХ ИНСТИТУТОВ МЯСНОЙ ПРОМЫШЛЕННОСТИ

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THE PREPARATION OF MEAT SPREADS BY ENZYMATIC DIGESTION

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ABSTRACT

Meat spreads with improved spreading quality were prepared by the addition of proteolytic enzymes to the raw meat mixture, followed by canning without precooking. The degree of spreadability was found to be entirely dependent upon the concentration of enzyme added, variable holding times prior to canning and sterilizing having no effect.

The addition of papain was found to produce bitter after-flavours in the finished product, the degree of off-flavour produced being proportional to the concentration of papain added. Nine freeze-dried papain fractions were prepared by water extraction and by alcohol and ammonium sulphate fractionation of crude papain. Activities of these fractions ranged from zero to 1.8 times that of the crude papain. Six fractions were obtained in substantial yield and four were production tested. All resulted in definite off-flavours.

It was established by flavour testing individual spread components, treated with papain and then canned and sterilized, that most off-flavours resulted from interaction of papain with protein. Trypsin and chmyotrypsin, while as effective as papain for producing products of satisfactory spreadability, did not give rise to serious off-flavours in the finished product.

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INTRODUCTION

Meat spreads for canning are normally prepared by precooking the meat ingredients, comminuting, and canning the fluid mixture. The consistency of the final product depends, among other things, on the degree of denaturation of the protein in the precooking operation, and also on the extent to which the product is processed following canning. The latter is more or less constant, being dictated by the amount of processing required for commercial sterility. The precooking operation, however, is variable and some difficulty has been encountered in preparing meat spreads with consistently good spreading characteristics.

EXPERIMENTAL

In our preliminary experiments it was found that meat spreads with much more consistent and smooth spreading characteristics could be prepared by adding a proteolytic enzyme to a raw comminuted meat mixture, using conventional sausage-making equipment, and dispensing entirely with the need for precooking facilities. 0.1% of crude papain was used in these experiments. This corresponds in strength to the papain described in the National Formulary (N.F.) VIII, 60 to 70 milk clotting units per gram.

The effect of digestion time and temperature was determined in a series of experiments in which time and temperature of holding prior to retorting was varied.

TABLE I

EFFECT OF TIME AND TEMPERATURE OF DIGESTION PRIOR TO RETORTING ON TEXTURE AND FLAVOUR OF MEAT SPREADS

Digestion Prior to Retorting			
Time (mins.)	Temp. (°C.)	Texture	Flavour
nil	21	Excellent	Bitter
10	71	Excellent	Bitter
30	71	Excellent	Bitter
30	54	Excellent	Bitter
60	54	Excellent	Bitter

The concentration of enzyme in these experiments was 0.1%, the time or temperature of digestion apparently having no effect on the texture of the finished product. A bitter off-flavour was noted in all of the samples after retorting.

In a second series of experiments, the concentration of papain added was varied, the samples being canned and retorted immediately after preparation.

TABLE II

EFFECT OF CONCENTRATION OF PAPAIN ADDED ON TEXTURE AND FLAVOUR OF MEAT SPREADS

% Crude Papain Added	Texture	Flavour
nil	Solid loaf.	Good
0.005	Too Stiff to spread. Softer than control.	Sl. Bitter
0.01	Difficult to spread.	Bitter
0.05	Spreading characteristics good.	Definite off-flavour.

Since the level of off-flavour found increased with the concentration of papain used, it was felt that this flavour, or part of it, could be due to impurities or breakdown products of these impurities in the papain.

The crude papain used in the previous experiments was fractionated in three ways yielding a total of nine fractions. In the first fractionation, the crude papain was ground with water, filtered, the residue extracted several times with water, and the combined filtrates freeze-dried. The resultant powder was creamy-white in colour, had very little odour, and was obtained in a yield of 56%. Its activity, as determined by the beef digestion method (1), was 1.3 times that of the crude papain.

In the second fractionation, a water extract of the crude papain was again prepared, the filtrate being made 60% saturated with solid ammonium sulphate and allowed to stand overnight at 5°C. The precipitate was recovered, dissolved in water, dialysed against running tap water for 48 hours, then freeze dried. The resultant powder was again creamy-white in colour, was obtained in a yield of 23%, and had an activity of 1.5 times that of the crude papain.

Additional fractions were obtained with saturated ammonium sulphate and also from the final supernatent, but these fractions showed low activities, or were present in low yield, and were not tested.

In the third fractionation, a water extract of the crude papain was treated with an equal volume of 95% ethanol and the precipitate recovered by centrifuging. This first fraction came down at an alcohol concentration of 47.5%. The precipitate was freeze-dried to give a white powder with a yield of 6.9% and an activity 1.1 times that of the crude.

Additional precipitates were recovered at alcohol concentrations of 63.3%, 84.4%, and 86.4%. All were freeze dried. The yield of the second precipitate was 6.6% and the activity was 1.8 times that of the crude. Yields of the third and fourth precipitates were low, and the material from the final supernatent was totally inactive. None of these fractions was tested.

The four major fractions were used to prepare meat spreads. A control containing crude papain and a "spread" with no papain added were also prepared. The purified papain preparations included the water extracted material, the first fraction from the ammonium sulphate precipitation, and the combined fractions from the first two alcohol precipitations.

All samples with papain added had the characteristic off-flavour noted in previous tests, indicating that the bitter flavour was due to action of the papain itself rather than to impurities in the crude material.

A series of tests was next conducted to determine which materials in the spread mixture interacted with the papain to produce the off-flavour. Crude papain was added separately to the various ingredients used in preparing ham spread. The individual ingredients, with and without added papain, were canned, retorted, and organoleptically tested for off-flavour.

TABLE III

FLAVOUR OF HAM SPREAD INGREDIENTS INDIVIDUALLY PROCESSED WITH AND WITHOUT ADDED PAPAIN

Ingredient	Papain Concentration	Off-Flavour
Water	nil	none
Water	0.10%	none
Ham, cured	nil	none
Ham, cured	0.10%	Bitter
Ham fat	nil	none
Ham fat	0.10%	none
Wheat Flour Slurry	nil	none
Wheat Flour Slurry	0.10%	very bitter
Mixed Spice in water	nil	none
Mixed Spice in water	0.10%	none

Off-flavours were noted only in the ingredients containing substantial levels of protein, indicating that protein breakdown products were responsible. Both trypsin and chymotrypsin, added as purified enzyme in 0.05% concentration, gave products with good spreading characteristics and more satisfactory flavour. The cost of these purified enzymes, however, prohibits their use for this purpose.

DISCUSSION

Papain has been used extensively for tenderizing lower quality meat, apparently without adverse effect on flavour. However, the degree of protein breakdown sought in this case is much less than that required for the preparation of spreads without precooking. The optimum concentration of N.F. VIII strength papain required to tenderize lower quality beef steaks is about 0.0015%, in contrast to the minimum of 0.05% concentration required for preparing spreads without precooking.

It is, therefore, perhaps not surprising that this relatively high concentration of papain, coupled with the extensive heat treatment necessary to obtain a product of commercial sterility, resulted in a degree of protein hydrolysis that gave rise to undesirable flavours. However, there are indications from our very limited work with trypsin and chymotrypsin that it may be possible, by a proper selection of enzymes, to obtain the required degree of breakdown without the production of off-flavours. At the current price of papain it is possible to produce spreads of improved spreading quality with the elimination of precooking equipment and labour, for an enzyme cost of

about 0.5 cents per kilogram. Many proteolytic enzymes are now available at relatively low cost and we are hopeful that one of these may eventually make this process a commercial success.

REFERENCE

(1) The National Formulary, Edition VIII, p. 372. American Pharmaceutical Association, Washington, D.C., U.S.A.


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