# Use of mechanically deboned meat for manufacture of meat products

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When slaughtered animals are dismembered and the meat is deboned, as much as 5-1o % of the total meat may remain on the bones. Manual removal of this residual meat from the bones is a very work-consuming operation. The efficiency of manual separation of meat and bones can be increased with mechanical, cyclic deboning apparatus, but the method requires a considerable work force and results in a higher calcium content in the recovered meat.

To eliminate the disadvantages of the traditional meat - bone separation procedures, mechanical deboning equipment has been employed for more than 1o years. Some of the various mechanical procedures operate continuosly, e.g. the PAOLI and BEEHIVE systems; others are intermittent, e.g. the PROTECON, INJECT STAR and AMERSFOORT systems; while still others are combinations of these two modes of operation, e.g. the HERTA KS and STOCKMEYER systems.

There are important quality and hygiene conditions for the factory introduction of mechanical deboning. Although different criteria hold in the various countries, the most important of the quality conditions are the calcium and bone contents of the residual meat. Since we planned to use mechanically deboned meat /MDM/ to prepare various meat products /Bologna sausage, sliced meats, smoked sausage and black and white puddings/, we carried out plant-scale experiments with intermittent-operating equipment, not containing a bone grinder or a precrusher, in order that the calcium and bone contents of the basic MDM material for use should be minimum. This work involved equipment with PROTECON, SELO MRS-2o P and INJECT STAR 6o P systems.

The mechanical deboning experiments were performed on pig bones preliminarily separated by hand. The main chemical parameters of the MDM pastes obtained with the two deboning procedures are presented in Table 1.

| Bone | Pressing | Water | Fat | Ash | Ca | Meat protein | Connective tissue protein | Relative connecti ve tissue protein | Feder index | Fat-protein index |
|---|---|---|---|---|---|---|---|---|---|---|
| | | % | % | % | % | % | % | % | | |
| Mixture A | I | 49,2o | 38,36 | o,75 | o,o8 | 12,34 | 2,68 | 21 | 3,99 | 3,11 |
| | II | 51,63 | 34,4o | 1,57 | o,26 | 13,oo | 3,14 | 24 | 3,97 | 2,65 |
| Mixture B | I | 43,4o | 46,87 | o,74 | o,o9 | 11,14 | 2,16 | 19 | 3,88 | 4,21 |
| | II | 49,62 | 39,4o | 1,16 | o,22 | 12,2o | 3,76 | 31 | 3,o7 | 3,23 |

A : pig chine + rib bones; B : pig chine + rib + ham bones;

I : PROTECON SELO MRS-2o P; II : INJECT STAR 6o P

On the basis of these tabulated data it may be stated that the meat paste obtained with the PROTECON SELO type apparatus has a minimum calcium content: o,o8-o,o9 %, its relative connective tissue protein content is lower than that of the paste obtained with the INJECT STAR equipment, and the FEDER and fat - protein indices are acceptable from the aspect of processing. The bone content is less than o.5 % in both procedures, and two-thirds of the bone fragments did not exceed 1 mm in size.

Experiments were also carried out with the PROTECON SELO apparatus on various pig bone mixtures. Table 2 gives the chemical compositions of the meat pastes obtained from such mixtures.

Table 2. Chemical compositions of meat pastes obtained from pig bones with the PROTECON SELO MRS-2o P apparatus.

| Bone | Water | Fat | Ash | Ca | Meat protein | Connective tissue protein | Relative connecti-ve tissue protein | Feder index | Fat-protein index |
|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | | |
| A | 49,2o | 38,36 | o,75 | o,o8 | 12,34 | 2,68 | 21,72 | 3,99 | 3,11 |
| B | 28,28 | 67,87 | o,47 | o,1o | 6,27 | 2,5o | 39,87 | 4,51 | 1o,82 |
| C | 43,4o | 46,87 | o,74 | o,o9 | 11,14 | 2,16 | 19,39 | 3,88 | 4,21 |
| D | 33,8o | 57,9o | o,87 | o,17 | 7,88 | 2,48 | 31,47 | 4,29 | 7,35 |

A : pig chine + rib bones; B : pig shoulder + ham + pelvic bones;
C : pig chine + rib + ham bones; D : pig pelvic bones

The tabulated data demonstrate that the calcium contents of the meat pastes obtained from the chine, rib and ham bones are less than o.1o%, whereas that of the pelvis, o.17 %, is very high.

As concerns the bone content, the quality of the meat pastes prepared from the four types of bone mixtures is satisfactory: two-thirds of the bone fragments tures is satisfactory: two-thirds of the bone fragments present were smaller than 1 mm, while the total bone content was less than o.5 %.

The meat pastes prepared from bone mixtures A and C contain more than 11 % meat protein, which corresponds to the protein content of 3rd 4th class pig meat. The protein contents of the meat pastes obtained from bone mixtures B and D are so low that in themselves they are not suitable for meat substitution during processing. The relative connective tissue protein contents indicate that processing of bone mixtures A and C is most reasonable; the relative connective tissue protein content of the meat paste obtained is less than 21 %.

As regards the FEDER index, processing of bone mixtures A and C is fabourable; the tabulated values of 3.88 and 3.99 correspond to those for pared meats. The FEDER indices of the meat pastes obtained by processing of bones B and D are much higher than the Values of 3.7-3.9 measured for meats in general. A number of literature references indicate that the FEDER indices of separated meats display an anomaly, with a value above 4 /LINKE, ARNETH, BEM, 1974/. In accordance with the literature findings, the FEDER indices for the meat pastes obtained from bone mixtures B and D exhibited anomalies, with values of 4.29 and 4.51, respectively.

With the fat - protein index as basis, the MDM basic material obtained from bone mixtures A and C proved satisfactory. The values in the cases of bone mixtures B and D were exceptionally high, 1o.82 and 7.35, which are unfavourable from a technological aspect.

The processing of the MDM in the meat industry requires great circumspection. Although this does not involve a greater risk than the processing of manually deboned meat /PSOTA, 1981/, it is very important to adhere to the following conditions: it is advisable to begin the mechanical processing of bone mixtures within 3 hours of the completion of manual preboning; bones should be stored below 1o°C before processing; the MDM basic material should be stored at a maximum of 2 °C and processed within 24 hours. The MDM basic material, frozen in a layer thickness of 8-1o cm, may be stored in a cold store for at most 18o days. The total number of germs in the MDM basic material prepared in our experiments and not frozen was $1o^3$-$1o^4$/g; under the experimental conditions /storage for 24 hours at 2 °C/, this did not increase substantially. In a study of the proportions of the MDM basic material than can be used in meat products, it was used in the experimental manufacture of Bologna sausage, sliced meats, boiled smoked sausage, and black and white puddings. The quality of these experimental products was examined by sensoric tests and chemical analysis. The most important of the sensoric parameters were the colour, taste and consistendy, while the main chemical properties were considered to be the fat and protein contents. Table 3 shows the influence of various proportions of MDM on these parameters.

Table 3. Quality of meat products prepared with MDM

| Products | MDM | Water | Fat | Meat protein | Taste index /maximum 4o/ | Overall index /maximum loo/ |
|---|---|---|---|---|---|---|
| Bologna sausage | o | 62,6 | 2o,5 | 13,8 | 35,7 | 84,o |
| | 5 | 65,1 | 19,o | 12,9 | 32,1 | 82,o |
| | lo | 64,9 | 19,5 | 12,5 | 3o,5 | 78,o |
| Sliced meat | o | 55,9 | 25,o | 16,o | 36,o | 85,o |
| | 5 | 51,6 | 3o,o | 15,4 | 34,o | 84,o |
| | lo | 52,8 | 31,o | 13,2 | 3o,5 | 79,o |
| Smoked sausage | o | 56,5 | 23,o | 17,o | 36,3 | 85,o |
| | 5 | 54,7 | 26,o | 16,3 | 34,5 | 83,5 |
| | lo | 56,1 | 24,5 | 16,4 | 32,1 | 81,5 |
| | 15 | 49,4 | 31,5 | 15,5 | 3o,o | 77,1 |
| Black and white puddings | lo | 5,17-58 | 19,5-25,8 | 12,5-12,8 | 4o | 89-loo |

As a results of the investigations, it may be stated that when MDM is used in 5 mass % to prepare Bologna sausage and sliced meat, or in lo mass % to prepare smoked sausage or black and white puddings, it does not cause an essential change in the quality of the end-product. There was no alteration in the duration of the period for which the products prepared with MDM could be kept, and a faster rancidification /higher peroxide number/ was not observed as a result of the increased bone fat ratio. These findings are in agreement with literature reports that rate of oxidation of the lipids /the rate of rancidification of the products/ is not changed essentially by the higher bone fat ratio /KUNSMANN et al., 1978/.

The experimental manufacture results led to the preparation of new meat products too with the use of MDM: Szegedi and Tápéi liverwurst, and Dorozsmai tongue. The general hygienic conditions of processing of MDM have been detailed above. From the aspects of the processing technology and the sensoric quality and chemical composition of the meat products, it is of great importance to establish and fix the quality conditions relating to the MDM basic material.

To summarize, the quality parameters of MDM suitable for the manufacture of meat products are as follows:

The maximum calcium content of the meat product prepared with the MDM may be o.15 %, i.e. the permitted calcium content of the basic material is o.6-o.8 %.

The maximum FEDER index of the MDM basic material is 4.o, and its maximum fat - protein index is 4.5. These parameters correspond to those for 3rd and 4th class meats.

The meat protein content of the MDM basic material may be at most 11 %, and its relative connective tissue protein content at most 25 %, similarly as for 3rd and 4th class meats.

A value of o.5 % is accepted as reasonable for the bone content, but we consider it more important, for physiological reasons, that two-thirds of the bone fragments to be found in the MDM basic material should be samller in size than 1 mm, and that no bone or gristle particles larger than 3 mm should be present.

References:

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