PACKAGING FRESH AND CURED MEATS

SESSION L: GENERAL PAPERS ON PACKAGING

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The four papers submitted to this session are quite unrelated and I consider that I can perform my role as rapporteur best by summarizing each paper in turn and attempting to bring out their main conclusions.

The first paper I shall take is L2, titled: "Changes in some qualities of canned poultry meat during storage". It deals with the effect of time and temperature on the chemical and sensory properties of a variety of canned poultry products so that limits of storage may be defined.

All the products were heat processed in hot-dipped tinplate cans without internal coatings, and were stored for up to 3 years at ambient and refrigerated temperatures. The meat contents were examined immediately after processing and periodically throughout storage. Chemical tests were carried out to follow degradation of the meat with time, and its contamination as a result of corrosion of the tinplate containers. Contents were also assessed organoleptically, and microbiological examination showed absence of pathogenic organisms in all samples throughout storage.

First of all, changes in the protein content were considered. Analysis of -amino nitrogen showed that heat sterilization caused hydrolysis of proteins, leading to changes in texture, and accumulation of low molecular weight nitrogenous compounds, hydrogen sulphide, carbonyls, carbon dioxide, etc. -amino nitrogen increased during the whole of storage in all the products tested. The rate of hydrolysis was reduced slightly by refrigerated storage. These protein changes are undoubtedly also responsible for deterioration of both flavour and appearance of these products.

Next, the authors deal with changes in the fat components. Lipid hydrolysis and oxidation during storage was evidenced by increasing numbers of fatty acids and peroxides Table 1 (p. 197). Fatty acids had increased almost ten-fold by the end of 2 years' ambient storage and only slightly less when refrigerated. Beyond this period they increased further in much the same fashion as the peroxide values. The rate of increase was again greater at the higher storage temperature. A similar temperature dependence was also observed with the accumulation of carbonyl compounds during storage. Their increase, at both temperatures, was most pronounced after 30 months.

The level of volatile free fatty acids varied considerably but a general increase was observed at the end of 36 months. The variations were attributed to differences in chemical

composition of the canned products, and their accumulation was regarded as indicative of hydrolytic decomposition of fats and possible deamination of amino acids with the formation of low molecular fatty acids.

During prolonged storage the tinplate containers were subject to corrosion, and this also contributed to deterioration of the canned meat. Sulphide staining of the unprotected can interior was evident immediately after sterilizing. As a result of corrosion, tin and later iron, dissolved in the meat products and appreciable quantities were present after 1 year and continued to accumulate thereafter. The rate of accumulation was slightly faster at ambient storage where the maximum permitted level was reached after $2\frac{1}{2}$ years. This limit was not reached until 3 years when refrigeration was used.

Products differed somewhat in their corrosive effect, as shown by surface porosity. Perhaps the authors would like to give the pH values of the various products and suggest the effect any differences might have on tinplate corrosion.

Lastly we come to sensory changes. The chemical changes in canned meat during storage, together with the results of tinplate corrosion lead to the accumulation of substances which adversely affect organoleptic quality. In this study such changes did not affect flavour noticeably until the third year of storage, during which unpleasant after-tastes and strong metallic off-flavours developed. This was most marked at ambient storage.

The authors conclude that the storage limit for poultry meat in un-lacquered tinplate cans is 2 years at ambient (10° to $25^{\circ}C$) and $2\frac{1}{2}$ years under refrigeration (O° to $4^{\circ}C$). They do not speculate on the corresponding storage life which would have been obtained with appropriately lacquered cans.

I now wish to turn to paper L4 titled "Utilization of chromium-plated steel cans in canned meat production". The authors point out that a major part of the world's production of tinplate is used in food canning, and due to increasing demands and rising prices, alternative materials are being sought for can manufacture. Chromium-plated low carbon steel is one such substitute. First produced in Japan, it is now marketed in a variety of forms. This material cannot be soldered and therefore can be used only for drawn can manufacture or for the ends of tinplate walled cans.

The lacquers used to protect tinplate may be used even more effectively with chromium-steel cans. In addition, chromium-steel is resistant to staining and can be used with a variety of products. Very little data is available however, and its suitability for canned meat and meat products.

In this paper, the authors seek to provide such information by comparing the performance of chromium-steel and tinplate cans both with and without protective lacquers, when used with typical meat products.

The cans and their protective coatings were as follows:

Can material	Protective coating
Chromium plated steel (CANSUPER)	no lacquer
Electrolytic tinplate E1 (RASSELSTEIN)	5g/m^2 epoxyphenolic (HERBOL)
Electrolytic tinplate E2 (RASSELSTEIN)	7g/m^2 epoxyphenolic, pigmented with aluminium (HERBOL)

Each protective lacquer was used with each can material. The meat products used in this study were cured minced pork, cured pork chops, cured beef chops and sour cabbage with pork. All canned products were stored for up to 4 years at room temperature, with periodic examination after 1, 6, 12, 24 and 48 months.

Cans were examined before use and although all had almost the same amount of mechanical damage to their interiors, there were differences in the porosity of the metallic coatings, as shown in Table 1 (p. 204).

The authors make the interesting observation that, although the porosity of the metallic coatings on the CANSUPER cans was considerably higher than that of the tinplate cans, when they were lacquered the chromium cans were superior to similarly lacquered tinplate cans. This they attributed to chemical interaction between the chromium coating and the lacquer during the stoving process. It was also observed that inclusion of pigment in the lacquer reduced adhesion to the chromium steel surface.

Visual examination of the cans during storage showed that those which were not lacquered were unsuitable for meat products since the cans showed several internal deterioration after only 1 year, and black spots developed with all products. In most cases these also discoloured the can contents. Lacquer coatings only delayed the discolouration, except in the case of the sour cabbage and pork where there were no changes. In addition to the black discolouration a yellowish brown discolouration was observed in the canned pork chops and cured minced pork. Although there is no information on pH in the printed paper, the author has this and can provide the values later.

Where corrosion was most severe, metallic off-flavours were detectable in the meat.

An interesting phenomenon was observed with pork chops in lacquered chromium cans. After 2 years and 4 years, white crystals identified as iron compounds appeared between the internal surface of the can and the contents. The iron content in the meat was 130-170 ppm and all samples had off-flavours.

Fig. 3 (p. 204) shows the levels of metallic residues in the meat products and demonstrates that the use of chromium plating did not increase the chromium content in the meat above the level which obtained with tinplate cans.

Iron content however was higher in every case with the chromium cans. This, the authors attribute to the electrochemical differences between chromium and tin. Unlike chromium, tin is a sacrificial coating, and porosity of sacrificial coatings does not greatly influence corrosion of the metal base.

In conclusion, the study shows that:

1. Lacquered drawn chromium plated steel cans, can be used with meat products.
2. Epoxyphenolic lacquers are suitable for protecting these cans. Pigmentation reduces adhesion between lacquer and chromium steel can.
3. Residual chromium in the meat contents is no higher than is found with tinplate cans.

The next paper L1, is titled "Effect of the time interval for temperature measurement on the precision of F-value determination". In it the author points out that, although different methods exist for determining the sterilization value of a canned food product, all of them require data on the temperature changes in the centre of the can during heat processing.

In calculating the sterilization value from a heat penetration curve, the temperature may be measured at intervals of time ranging from 1 minute to as much as 6 minutes. In this study, the effect which these different time intervals have on the calculated sterilization value has been examined using, as examples, three canned meat products with different processing characteristics.

The heat penetration curves for the 3 products are shown in Figures 1, 2 and 3 of the printed test.

These figures also show the sterilization or F-values obtained with time intervals of 1, 2, 3, 4, 5 and 6 minutes and it can be seen that there is considerable variation. In general, the F-value is lowest when the time interval is shortest and measurement therefore most precise.

The author concludes that although the difference between the highest and lowest values is less than 10%, determination of new thermal processes or optimisation of existing ones should be made with temperature measured at 1 or 2 minute intervals.

It seems to me that the precision of F-value determination may also be adversely influenced in other ways. For instance, the effect described in this paper must be influenced to a great extent by the relative shapes of the heating and cooling portions of the heat penetration curves. It must also be dependent on the shape and size of the can

being processed.

Finally, although the author does not state the Z value, presumably he has used lethal rate data for Z=18 and this can also be subject to variation.

All these will affect the precision of F-value calculations and this must be considered when specifying processing schedules.

The fourth and last paper, L3, which has nothing to do with packaging, is titled "A study of the biological value of meats produced by means of SHF heating".

The use of superhigh frequency or microwave heating for processing of meat products has been investigated by many workers. Organoleptically and physiochemically there is little difference between products treated in such a way and those processed by conventional heating. Technological problems may exist with non-homogeneous products where uniform treatment is difficult, but where homogeneous sausage-type products are concerned, control should be easier and more precise heating possible, with consequent benefits in biological value.

This study was carried out to compare the biological value of sausages processed by either SHF or traditional heating. Rats were fed diets containing either test or control sausages, or a protein-free diet in order to reveal endogenous losses. Food consumption was monitored during the experiment and weight gain determined before the rats were killed to provide samples for analysis.

The test group showed 16.7% more weight gain than the control group, but the test group also consumed slightly more protein than the control group. The protein efficiency ratio was calculated as in Table 1 (p. 200) where it is seen that the ratio for the test group is 7.3% higher than the control.

Analysis of liver homogenate showed that the test group contained more nitrogen than the control. The percentage of nitrogen in the food consumed was however also slightly higher in the test group.

Protein utilization in the liver was calculated as in Table 2 (p.200) and showed that the test group was 21% higher than the control. This difference however was not regarded as significant.

Blood protein level was similar at 6.6 to 6.7% for both test and control groups.

The sensitivity of the test and control sausages to proteolytic enzymes in vitro was markedly different. Fig. 1 (p.200) shoes that, during 3 hours pepsin treatment, the number of hydrolysates was greater with the test samples. After 3 hours, the total level in the test samples was 5915 µg compared with 5160 µg in the controls, a difference of nearly 15%.

When trypsin was added, differences in hydrolysate level was also observed, particularly during the 2nd and 3rd hours of digestion. At the end of 3 hours' treatment with trypsin, the total level was 4800 µg with test samples, compared with 3692 µg in controls, a difference of 30%.

With pepsin treatment there was no significant difference in the rate of hydrolysis but, with trypsin, the rate between 1 and 2 hours was 1.3 times higher in the test samples.

The authors conclude that:

1. The biological value of SHF processed sausages is greater than traditionally heat processed sausages.
2. A direct relationship was demonstrated between biological value indices of in vivo and in vitro experiments.