# CHILLED STORAGE OF SOY FLOUR-EXTENDED MINCED BEEF

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## SUMMARY

Extension with expression defatted soy flour did not decrease the shelf-life of plastic wrapped ground beef stored at 8 to 10°C, which was 4 days until off-flavour development. The addition of 400 mg $kg^{-1}$ of $SO_2$ as sodium metabisulphite extended shelf-life to 8 days.

Extension with soy flour increased microbial counts only slightly to moderately (maximum 1.3 log units average for lactobacilli), but did not apparently affect their rates of increase.

Average counts for psychrotrophs at the end of the shelf-life period were 5.9 for unextended minced beef, 6.2 for the extended minced beef and 8.3 for the extended, $SO_2$-preserved minced beef, suggesting that $SO_2$ not only hindered the growth of bacteria, but also affected their capacity to produce those metabolites responsible for organoleptic rejection of the product.

## INTRODUCTION

In Cuba, expression-defatted soy flour is commonly used as an extender for meat products. Cuban dishes based on minced beef are very often heavily seasoned, so that soy flour-extended minced beef would be quite acceptable to consumers as a low-cost alternative.

Many shelf-life studies have been carried out on soy-extended ground beef, mostly with textured soy protein (TSP) and storage at 4°C (Craven and Mercuri 1977; Bell and Shelef 1978; Foster et al. 1978; Harrison et al. 1981).

Generally, extension with TSP has been found to increase bacterial counts (Craven and Mercuri 1977; Keeton and Melton 1978; Draughon et al. 1982) and shorten the shelf-life of ground beef (Bell and Shelef 1978).

The keeping quality of this product should therefore be studied and, in view of occasionally high storage temperatures (up to 10°C), the need for some suitable preservative evaluated. Sulphur dioxide, used for a long time with great effectiveness in British fresh sausage (Dyett and Shelley 1966) has been indicated as an effective preservative for meats, in spite of widespread reservation (Flores 1981).

The aim of this work was to study the keeping-quality of minced beef extended with 12 % expression-defatted soy flour stored at 8-10°C, with and without addition of sulphur dioxide.

## MATERIALS AND METHODS

20 portions, ca. 350 g each, of unextended minced beef, 20 of minced beef extended with 12 % expression-defatted soy flour, and 20 of extended minced beef with 400 mg/kg of sulphur dioxide, added as sodium metabisulphite, were wrapped in plastic film and stored at 8-10°C.

Samples were taken daily for microbiological analyses and sensory evaluation. Test samples for microbiology were prepared following standard procedures (Anon. 1982a; 1982b).

Plate counts were made of mesophyllic aerobes (plate count agar, 37°C, 48 h); psychrotrophic aerobes (plate count agar, 4-6°C, 7 days); enterobacteriaceae (violet red bile glucose, 37°C, 48 h); lactobacilli (MRS agar, 37°C, 48 h) and fungi (malt extract agar with 0.2 % lactic acid, 30°C, 5 days).

In each case, regression analyses were carried out of the logarithms of the counts over the storage time.

For sensory analysis, 1.5 % salt was added, and small (ca. 20 g each) patties were formed, ca. 50 mm in diameter and 10 mm thick, which were fried in pork fat ca. 5 mm deep, at 150-160°C, until a core temperature of 70°C was reached.

Samples were served hot to a group of 7-10 experienced judges, in an acceptance-rejection test for off-flavour detection. The rejection criterion for any sampled unit was defined according to a binomial distribution with p = 0.1, for a significance level of 5 % (Andújar and Herrera, 1987).

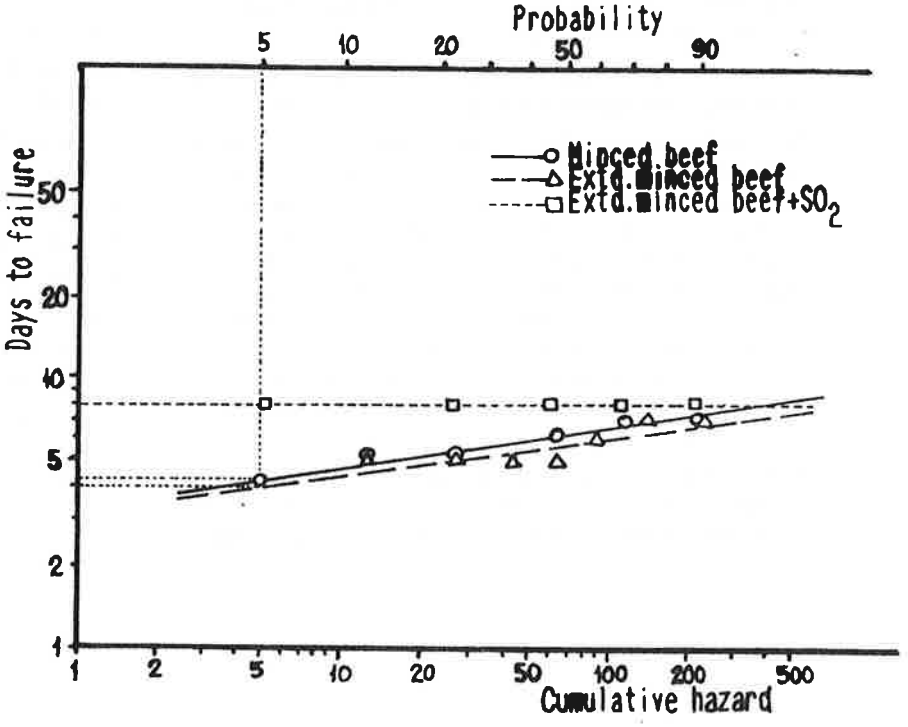


Figure 1.- Weibull hazard plot for the keeping-quality test.

For hazard plotting, the data were assumed to follow a Weibull distribution, according to previous results in similar experiments (Andújar and Herrera, 1987). Shelf-life was determined as the time to reach a failure probability of 5 % for any sampled unit.

## RESULTS AND DISCUSSION

Figure 1 shows the Weibull hazard plots for minced beef, minced beef extended with soy flour and extended minced beef with sulphur dioxide. Times to reach a 5 % failure probability were almost identical for unextended and extended minced beef: 4.2 and 4 days, respectively, whereas addition of sulphur dioxide increased this period to 8 days.

Figures 2 to 7 show the increase in plate counts during storage for mesophiles, psychrotrophs, enterobacteriaceae, lactobacilli, moulds and yeasts, respectively. Regression lines are also shown, which allow a better appreciation of trends, somewhat obscured by dispersion in experimental data.

In general, it can be noticed that extension with soy flour increased counts, as reported before for TSP (Craven and Mercuri 1977; Keeton and Melton 1978), albeit slightly.

The rates of growth during storage, as indicated by the slopes of the regression lines, were not affected by the extension with soy flour, different from Harrison et al. (1981). It is specially interesting in the case of lactobacilli (Fig. 5), as it dismisses the suggestion of Draughon et al. (1982) that their growth might be sustained by fermentation of soy oligosacharides.

As expected, sulphur dioxide was very effective against bacteria in general, lactobacilli being particularly susceptible. Growth of fungi was apparently stimulated (Figs. 6 and 7) by its use. $SO_2$ has been reported not to affect yeast counts substantially (Dalton et al. 1984). The observed effect might be due to inhibited competition.

Table 1 shows plate counts at the time of shelf-life termination (when 5 % failure probability was reached). It can be noticed that $SO_2$-treated samples reached much higher psychrotroph counts before they were rejected on the basis of organoleptic properties than their non-treated homologues, thus suggesting an effect of this additive on the production by bacteria of the metabolic products which are the object of the sensory detection of spoilage.

Fairly high counts have been reported for sulphite-treated British sausages sampled off the shelf. Dowdell and Board (1968) reported total counts up to 5 x $10^8$ col.$g^{-1}$, with many results relatively close to this figure.

## CONCLUSIONS

Extension with expression defatted soy flour did not decrease the shelf-life of plastic wrapped ground beef stored at 8-10°C, which was 4 days until off-flavour development. The addition of 400 mg $kg^{-1}$ of $SO_2$ as sodium metabisulphite extended shelf-life to 8 days.

Extension with soy flour increased microbial counts only slightly to moderately, but did not apparently affect their rates of increase.

It is suggested that $SO_2$ not only hindered the growth of bacteria, but also affected their capacity to produce those metabolites responsible for organoleptic rejection of the product.

## REFERENCES


Andújar, G. and Herrera, H. (1987) Proceedings 33 rd Int. Congress of Meat Science and Technology, p396.

Anonymous (1982a) Cuban Standard N.C. 76-02.

Anonymous (1982b) Cuban Standard N.C. 76-03.

Bell, W.N. and Shelef, L.A. (1978) *Journal of Food Science* **43**:315.

Craven, S.E. and Mercuri, A.J. (1977) *Journal of Food Protection* **40**:112.

Dalton, H.K., Board, R.G. and Davenport, R.R. (1984) *Antonie van Leeuwenhoek* **50**:227.

Dowdell, M.J. and Board, R.G. (1968) *Journal of Applied Bacteriology* **31**:378.

Draughon, F.A., Melton, C.C. and Stansbury, J.B. (1982) *Journal of Food Protection* **45**:699.

Dyett, E.J. and Shelley, D. (1966) *Journal of Applied Bacteriology* **29**:439.

Flores, J. (1981) *Revista de Agroquímica y Tecnología de Alimentos* **21**:471.

Foster, J.F., Hunderfund, R.C., Fowler, J.L., Fruin, J.T. and Guthertz, L.S. (1978) *Journal of Food Protection* **41**:647.

Harrison, M.A., Melton, C.C. and Draughon, F.A. (1981) *Journal of Food Science* **46**:1088.

Keeton, J.T. and Melton, C.C. (1978) *Journal of Food Science* **43**:1125.

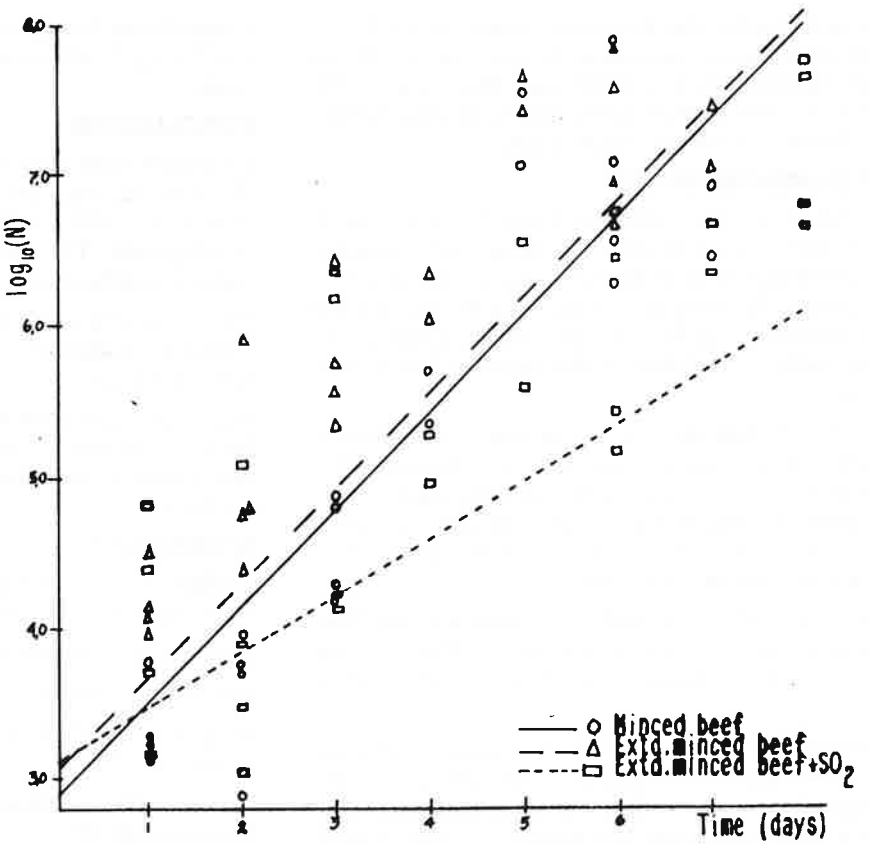


Figure 2.- Total plate counts. Mesophiles. Regression over time

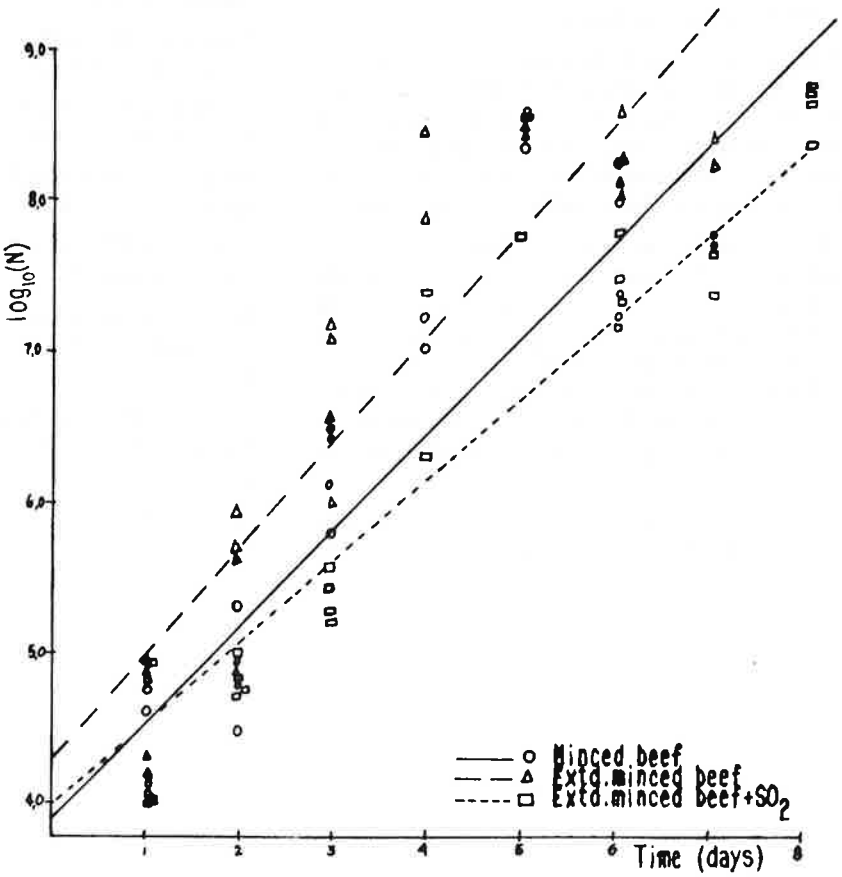


Figure 3.- Psichrotrophs. Plate counts. Regression over time

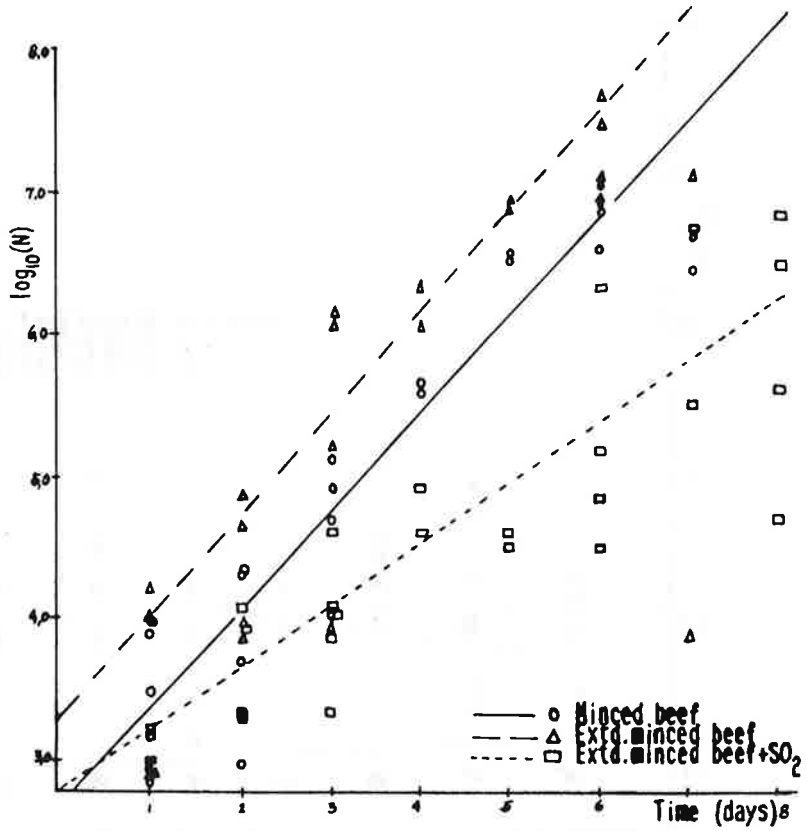


Figure 4.- Enterobacteriaceae. Plate counts. Regression.

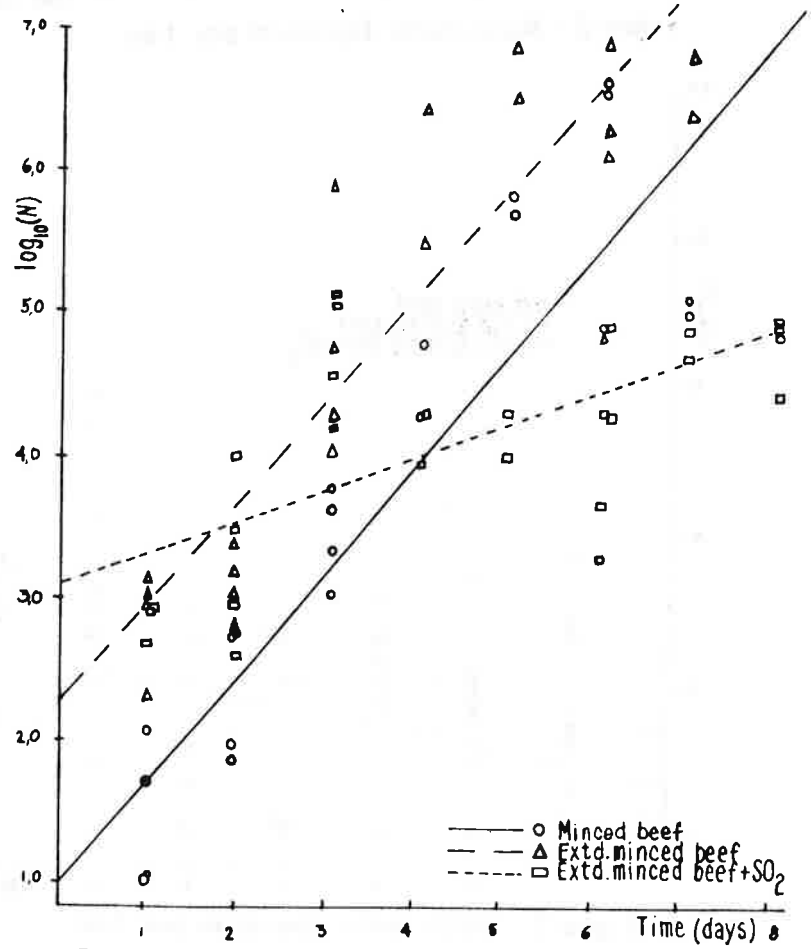


Figure 5.- Lactobacilli. Plate counts. Regression over time.

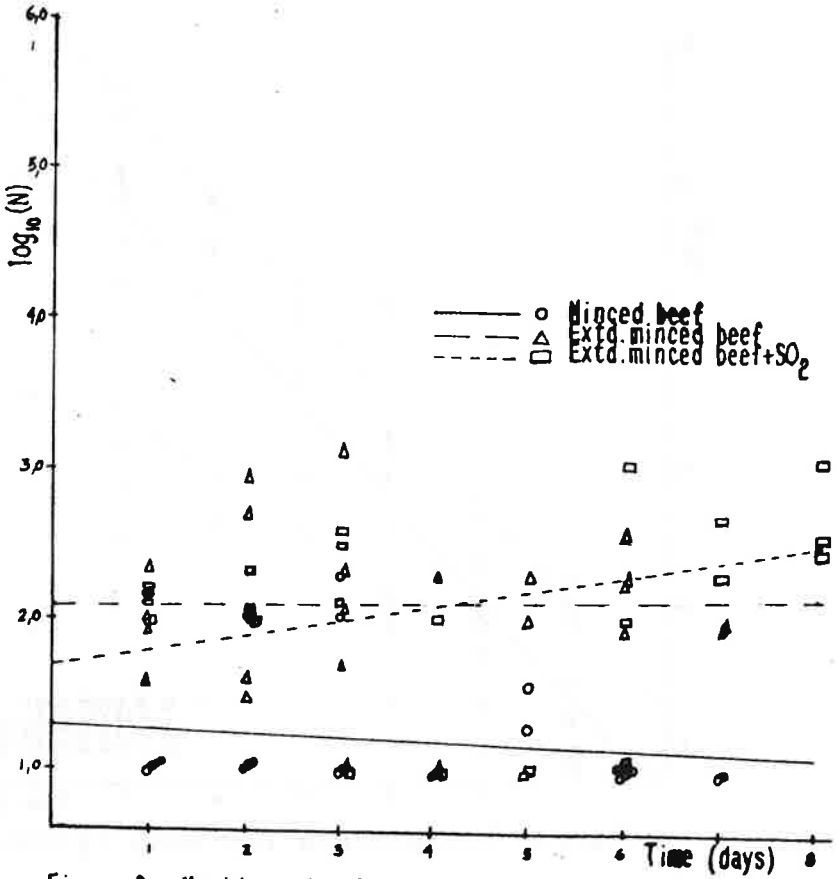


Figure 6.- Mould counts. Regression over time.

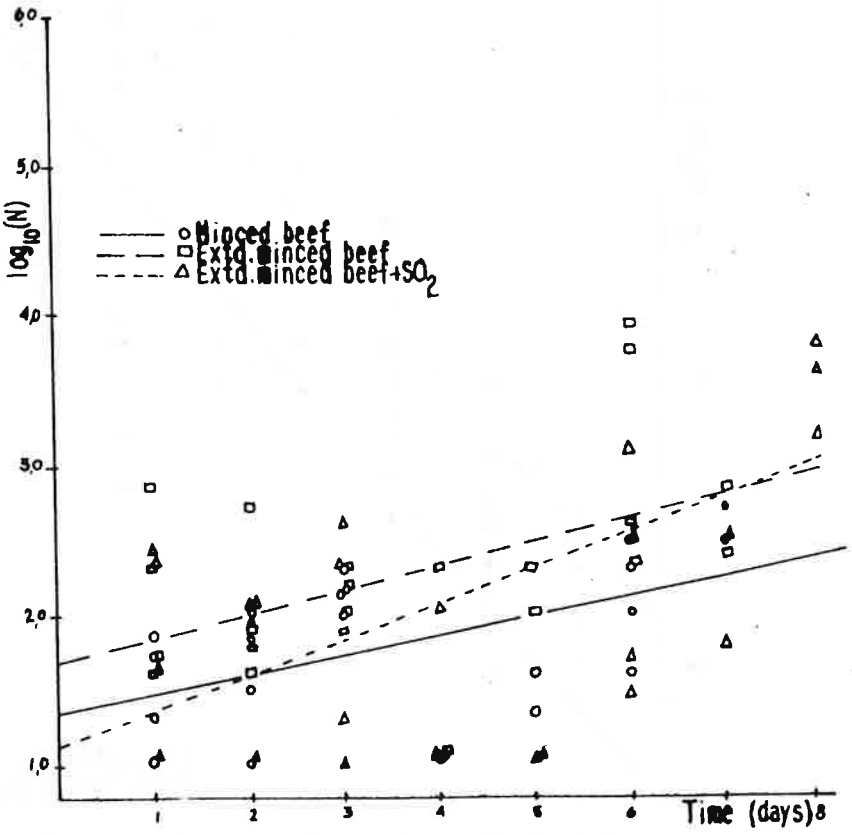


Figure 7.- Yeasts counts. Regression over time.