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كلية : الطب البيطري - جامعة الزقازيق فرع بنها  
رئيس القسم : أ.د / جمال الدين محمود العليمي .

## تأثير نترت الصود يوم وسوربيت البوتاسيوم على العد الكلي للميكروبات الهوائية في عجينة السجق

سعد محمود ، علاء المرشدي

تم دراسة تأثير تركيزات مختلفة من ملح النترت واضافات مختلفة من ملح النترت وملح السوربيت وملح الطعام على العد الكلي للميكروبات الهوائية في عجينة السجق عند ما تم حفظها في درجة ٤ - ٥ م لمدة عشرة أيام .

أثبتت الدراسات أن العد الكلي قد زاد في العينة الغير معاملة من ١٠ لو ١٠ الى ١٠ لو ١٠٠ ٠٨٣ . أما في المعاملات ٥٠ و ١٠٠ و ١٥٠ و ٣٠٠ جزء في المليون من ملح النترت كان العد الكلي لو ١٠ ١٢٣ و ١٢ و ١٠ و ٦ و ٩ على التوالي . أما نتيجة الأضافات المختلفة اثبتت أن اضافات ١٥٠ جزء في المليون ملح النترت مع ٠.٢٦٪ سوربيت مع ٢.٥٪ ملح الطعام لها نفس التأثير مثل ٣٠٠ جزء في المليون من ملح النترت .

ويتضح مما سبق أنه يمكن تقليل كمية ملح النترت في اللحوم المعاملة واستبدال جزء منه بملح السوربيت وملح الطعام .

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## EFFECT OF SODIUM NITRITE AND POTASSIUM SORBATE ON TOTAL COUNT OF AEROBIC MICROORGANISMS IN SAUSAGE PASTE (With 2 Figs.)

By  
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(Received at 25/6/1985)

### SUMMARY

The effects of different nitrite concentrations and combinations of nitrite, sorbate & salt on the total aerobic bacterial counts in sausage paste were assayed. All samples were held at 4-5°C for 10 days. The bacterial load of untreated sample extremely increased from 8.9 log<sub>10</sub> to 18.3 log<sub>10</sub> after 10 days refrigeration. While, total bacterial counts of 50, 100, 150 and 300 ppm nitrite-treatments reached 12.3, 12, 10.2 and 9.6 log<sub>10</sub> after 10 days refrigeration, respectively. Combinations of nitrite, sorbate & salt to reduce the amount of added nitrite in the paste were tried. The results pointed out that 150 ppm nitrite plus 0.26% sorbate plus 2.5% salt-treatment had nearly the same effect as that of 300 ppm nitrite-treatment in inhibiting aerobic bacterial growth in sausage paste.

### INTRODUCTION

The demand for sausage is increasing every year in the Egyptian market. The bacteriological quality of sausage paste is of concern to all chains of sausage industry. Generally, elements involved in sausage manufacture are subjected to contamination with spoilage and food-poisoning microorganisms which lead to a great risk for both the consumer and the producer. Reduced shelf life, discolouration, or even spoilage of the product due to this bacterial contamination are often encountered.

Sodium nitrite has been used for many years to prevent microbial growth, especially that of *Clostridium botulinum* (CHRISTIANSEN *et al.* 1973; HUSTAD *et al.* 1973; CHRISTIANSEN *et al.* 1974; TOMPKIN, 1983). In addition to its microbiological stability, nitrite is required to give typical colour and flavour to the cured meat products (HUSTAD *et al.* 1973; WASSER-MANN *et al.* 1977).

Recently, it has been shown that nitrite may react with naturally occurring amines (in tissues) to produce N-nitrosamines, which act as potent chemical carcinogens in experimental animals (MAGEE & BARNES, 1967; GREENBLATT & LIJINSKY, 1972; VERELTZIS & BUCK, 1984).

Many reviews on N-nitrosamines have been published in the past few years, dealing with their formation and occurrence in foods and their toxicology and human health hazards (FIDDLER, 1975; CROSBY, 1976; CROSBY & SAWYER, 1976; GRAY, 1976; GRAY & RANDALL, 1979). It has been found that the concentration of nitrite has the greatest role in the formation of nitrosamines, but the quantity of the amines has not any role (CRAY & DUGAN, 1974; IVEY

*et al.* 1978; ROBACH, *et al.* 1980).

Use of potassium sorbate to reduce or eliminate nitrite in cured meats is an area of current interest and research since addition of nitrite to foods has been questioned. In the U.S., sorbate is considered a generally recognized as safe (GRAS) compound (SOFOS *et al.* 1979) and appears to be one of the safest food preservatives available (SOFOS & BUSTA, 1983). Thus, it has been extensively used as a good preservative for many foods from dairy products to baked foods. There are numerous reports documenting the antimicrobial activity of sorbates in many foods and against a variety of important bacteria, including *Salmonella typhimurium*, *Escherichia coli*, *Pseudomonas sp.*, *Staphylococci*, *Bacilli*, *Vibrio parahaemolyticus*, *Clostridium botulinum*, and so on (EMARD & VAUGN, 1952; DOELL, 1962; PERRY, *et al.* 1964; PARK, *et al.* 1970; PARK & MARTH, 1972; RAEVUORI, 1976; ROBACH, 1978; ROBACH & HICKEY, 1978; PIERSON, *et al.* 1979; ROBACH & STATELER, 1980).

The purpose of this investigation is to determine the possibility of reducing nitrite in cured meat by studying the effect of using combinations of nitrite, sorbate and salt on the total aerobic count in fresh sausage paste.

### MATERIAL and METHODS

Beef meat sample (1 Kg) was trimmed and aseptically ground twice in electric grinder without any other additives to avoid any interference of other factors affecting life and death of microorganisms in the paste. The sample was divided into 8 subsamples, the first 4 subsamples were formulated, separately, with 50 ppm, 100 ppm, 150 ppm or 300 ppm of sodium nitrite (Sigma Co.). Three of the remaining 4 subsamples were formulated, separately, with 100 ppm nitrite plus 0.26% potassium sorbate (Sigma Co.), 150 ppm nitrite plus 0.26% sorbate, or 150 ppm nitrite plus 0.26% sorbate plus 2.5% common salt (Sigma Co.). The last remaining subsample was kept without any treatment as a control. Each treatment was mixed for 5 minutes in a sterile mixer, to obtain even distribution, and then wrapped in a sterile aluminium foil and kept at 4-5°C in the refrigerator.

Total plate counts were determined on days 0, 2, 4, 6, 8 and 10 of 4-5°C storage. Two 1-g sample were removed from each treatment using sterile technique. Appropriate serial decimal dilutions were prepared with 0.1% peptone water and used for inoculating triplicate pour plates of Plate Count Agar (Difco). All inoculated plates were incubated at 32°C for 3 days and then counted.

### RESULTS

Results obtained from bacteriological analysis of fresh sausage paste treated with different levels of sodium nitrite (0, 50, 100 & 300 ppm) and held at 4-5°C are shown in Fig. (1).

In case of using some combinations of nitrite, sorbate and salt to reduce the amount of added nitrite in meat, Fig. (2) demonstrates results of three combinations (100 ppm nitrite + 0.26% sorbate, 150 ppm nitrite + 0.26% sorbate, and 150 ppm nitrite + 0.26% sorbate + 2.5% salt) versus those of 300 ppm nitrite.

All results were plotted using log of actual colony counts versus days of storage at 4-5°C refrigeration. All points represent the average of 6 plates.

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## DISCUSSION

Regarding the nitrite treatments (Fig. 1),  $\log_{10}$  of the total plate counts for fresh sausage paste (zero time) both treated and untreated ranged from 8.7 - 8.9 ( $4.7 \times 10^8$  -  $7.4 \times 10^8$  colonies/g). After holding the samples under refrigeration (4-5°C), the untreated sample (control) revealed a substantial increase in bacterial load which reached 18.3  $\log_{10}$  after 10 days. Undoubtedly, if any further treatment or manufacturing happened, the initial bacterial load would be very high.

Bacterial growth in the samples formulated with 50 and 100 ppm nitrite was effectively inhibited in rate of 6  $\log_{10}$  lower than that of the control. But nitrite at concentrations of 150 and 300 ppm was effective in lowering the total number of aerobic bacteria in rate of 8-9  $\log_{10}$  lower than that of the control.

In the case of using some combinations (Fig. 2), no doubt that the 300 ppm nitrite treatment was the most effective in lowering microbial growth, but it is evident that the 150 ppm nitrite plus sorbate and 150 ppm nitrite plus sorbate & salt treatments were also effective nearly in similar degree as that of the 300 ppm nitrite.

Due to the potential reaction of nitrite in producing carcinogenic nitrosamines, addition of nitrite to meat must be so limited. Thus, use of sorbate or sorbate & salt with limited amount of nitrite (150 ppm) assumed to be more safe and preferable in curing of meat products.

Realizing, however, the other functions of nitrite in meat curing (e.g. colour, flavour), in addition to its antimicrobial properties, recent studies have shown that as little as 25-50 ppm nitrite is required to give typical colour and flavour (HUSTAD *et al.* 1973). However, other studies consistently indicate that at least 100-150 ppm nitrite is required to inhibit out-growth and toxin production by *Clostridium botulinum* (CHRISTIANSEN, *et al.* 1973; CHRISTIANSEN, *et al.* 1974). Moreover, the addition of 0.26% potassium sorbate neither affects the sensory qualities of meat nor were any side effects observed (PAQUETTE, *et al.* 1980; VERELTZIS & BUCK, 1984).

Therefore, sorbate can be a potential replacer of nitrite on the interest in reducing or eliminating the amount of nitrite from meat products for its possible harmful effects on human health through potential formation of carcinogenic nitrosamines.

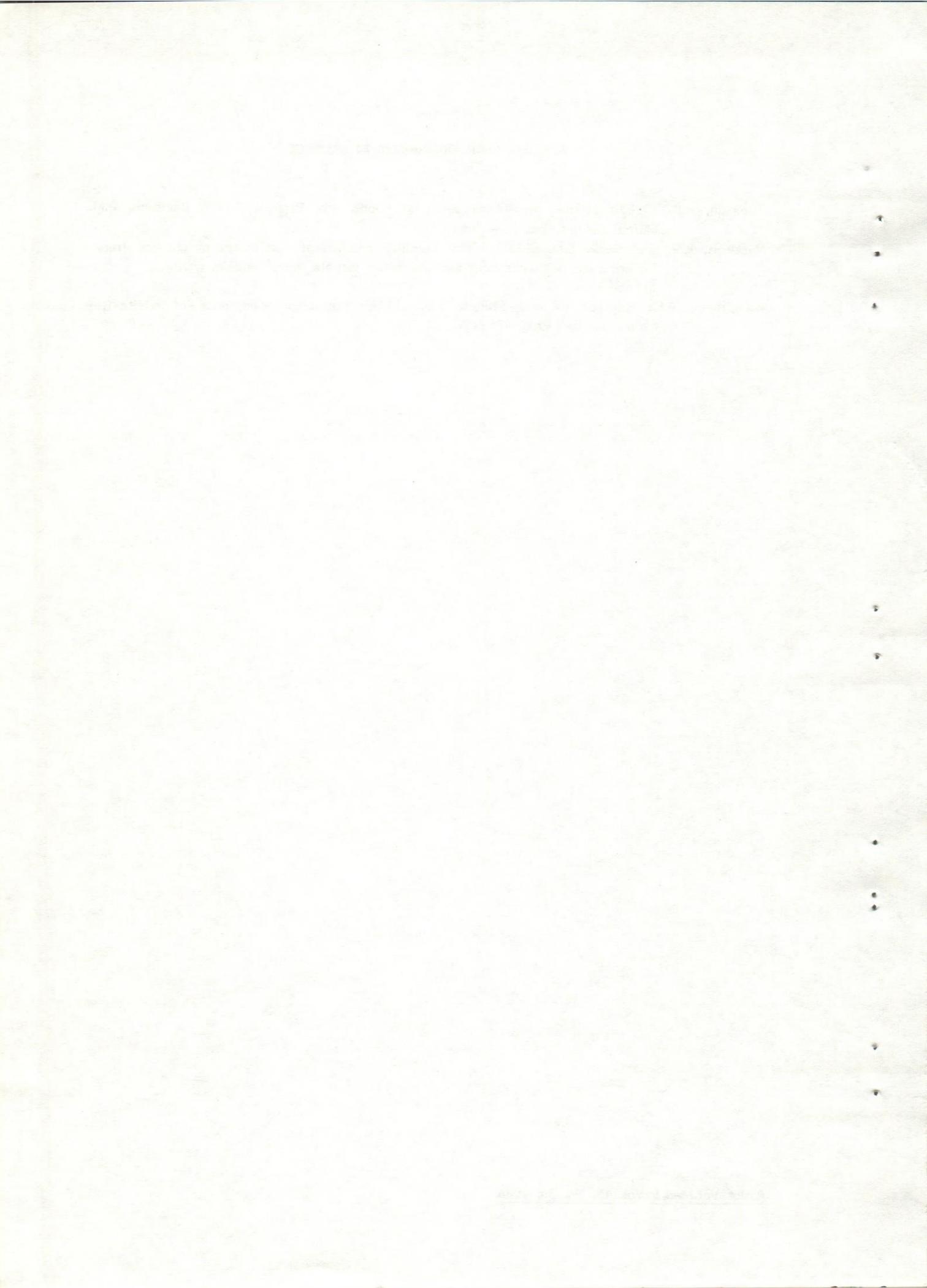
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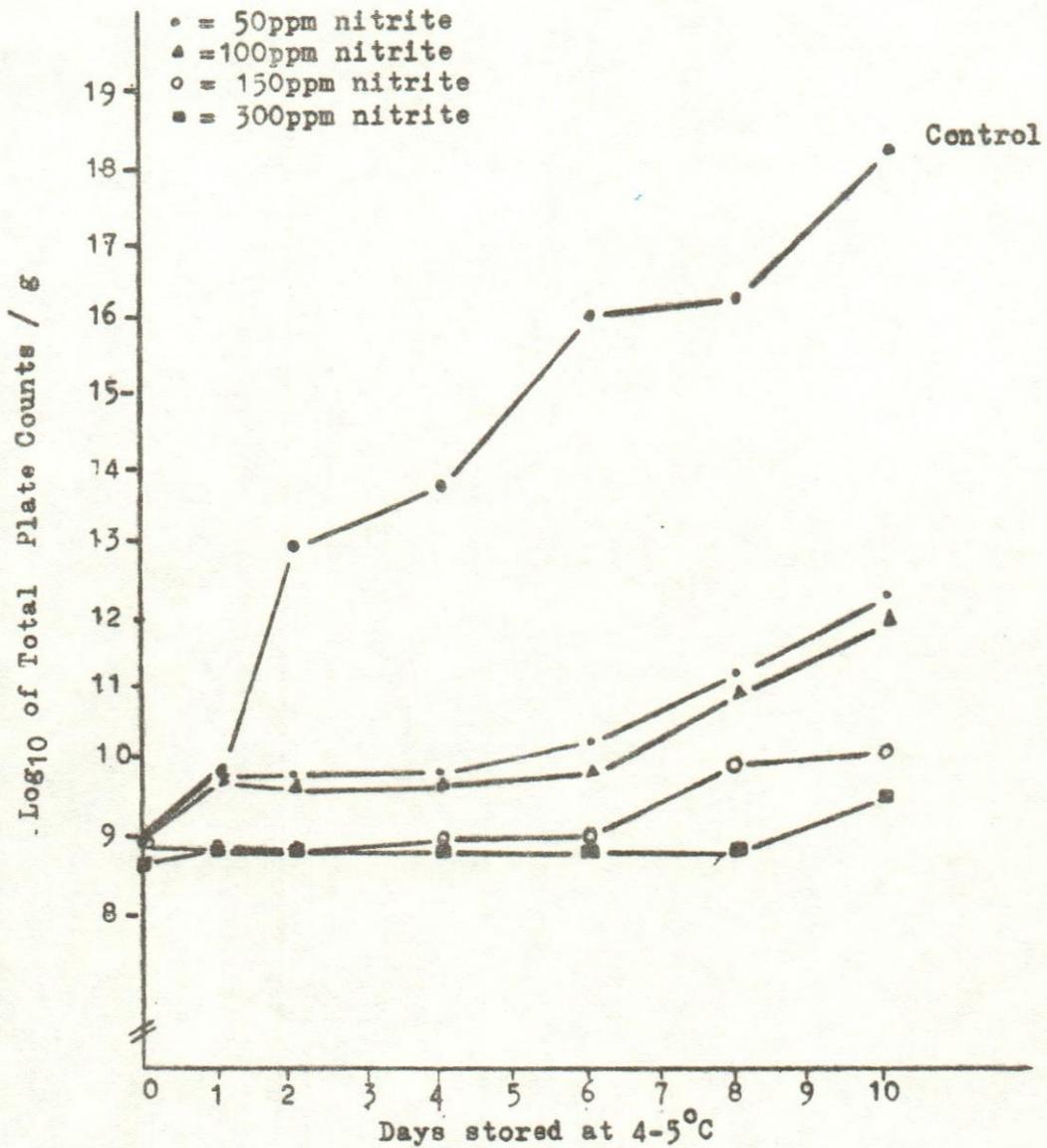


Fig. 1 Log<sub>10</sub> of total plate counts/g of sample versus days of storage at 4-5°C. The meat was formulated with the following additions: none, 50, 100, 150, & 300ppm Sodium nitrite. All points represent the average of 6 plates.

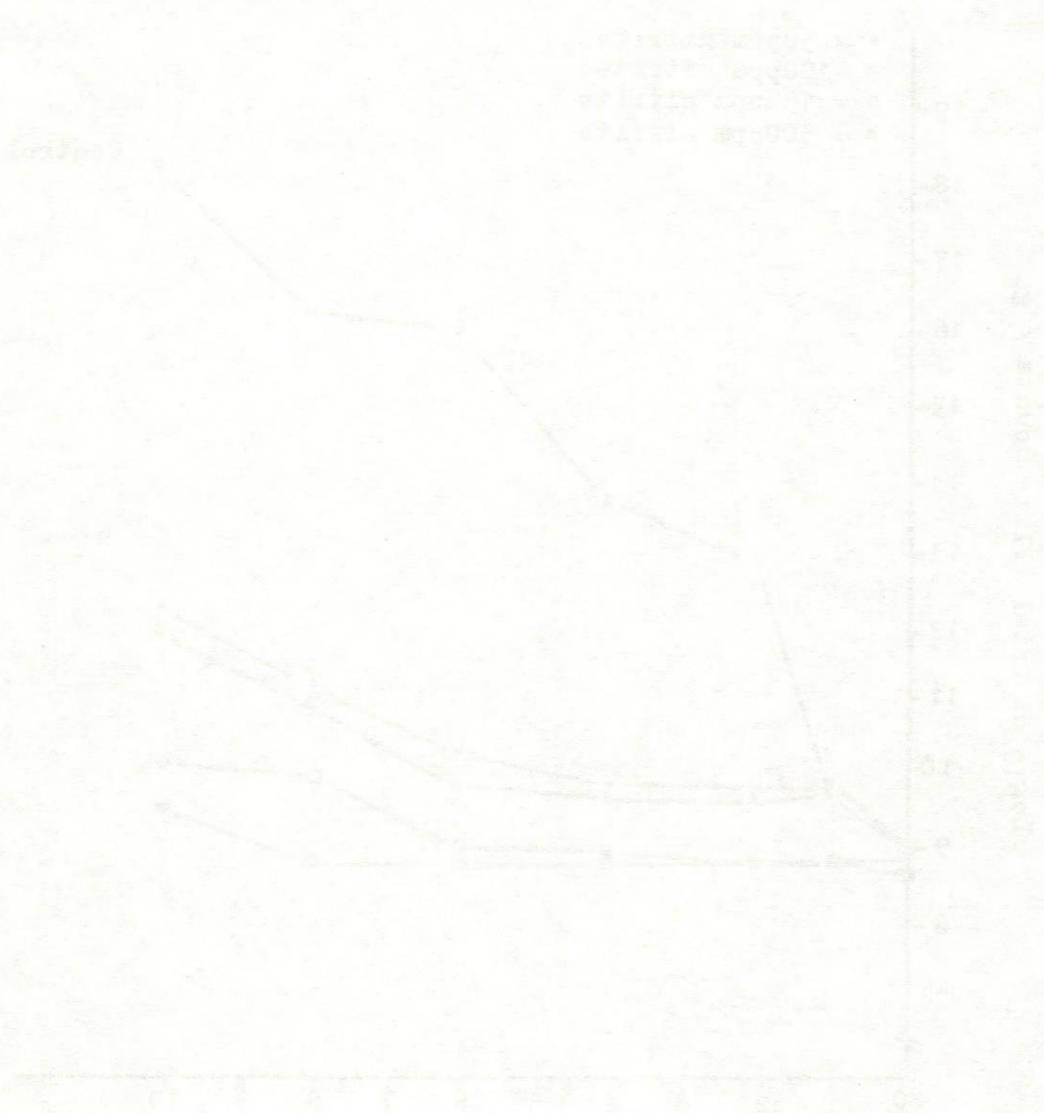


Fig. 1. Dependence of the average value of the parameter  $\alpha$  on the time of observation. The curves correspond to different values of the parameter  $\beta$ . The values of  $\beta$  are: 1) 0.1; 2) 0.2; 3) 0.3; 4) 0.4; 5) 0.5; 6) 0.6; 7) 0.7; 8) 0.8; 9) 0.9; 10) 1.0.

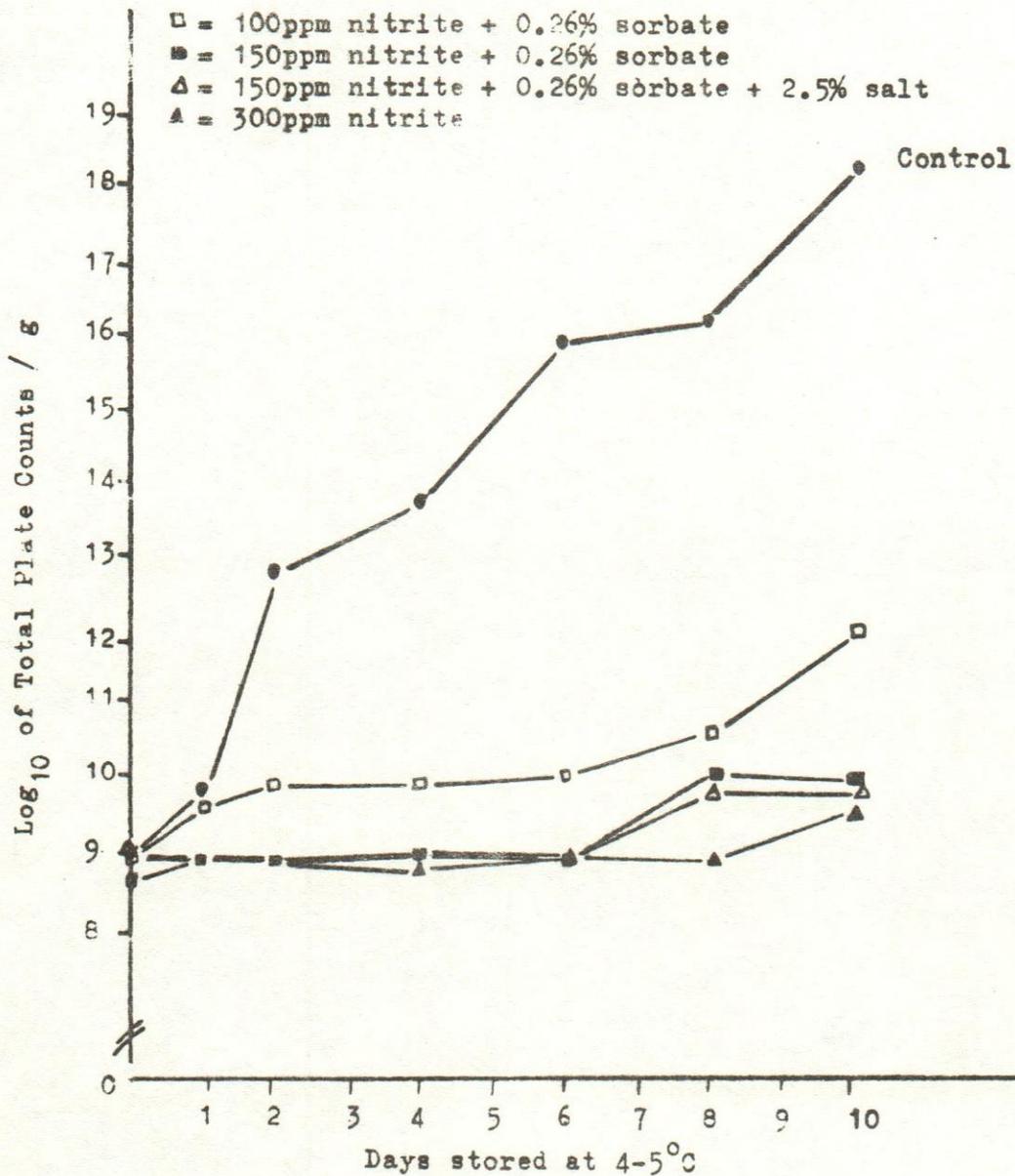
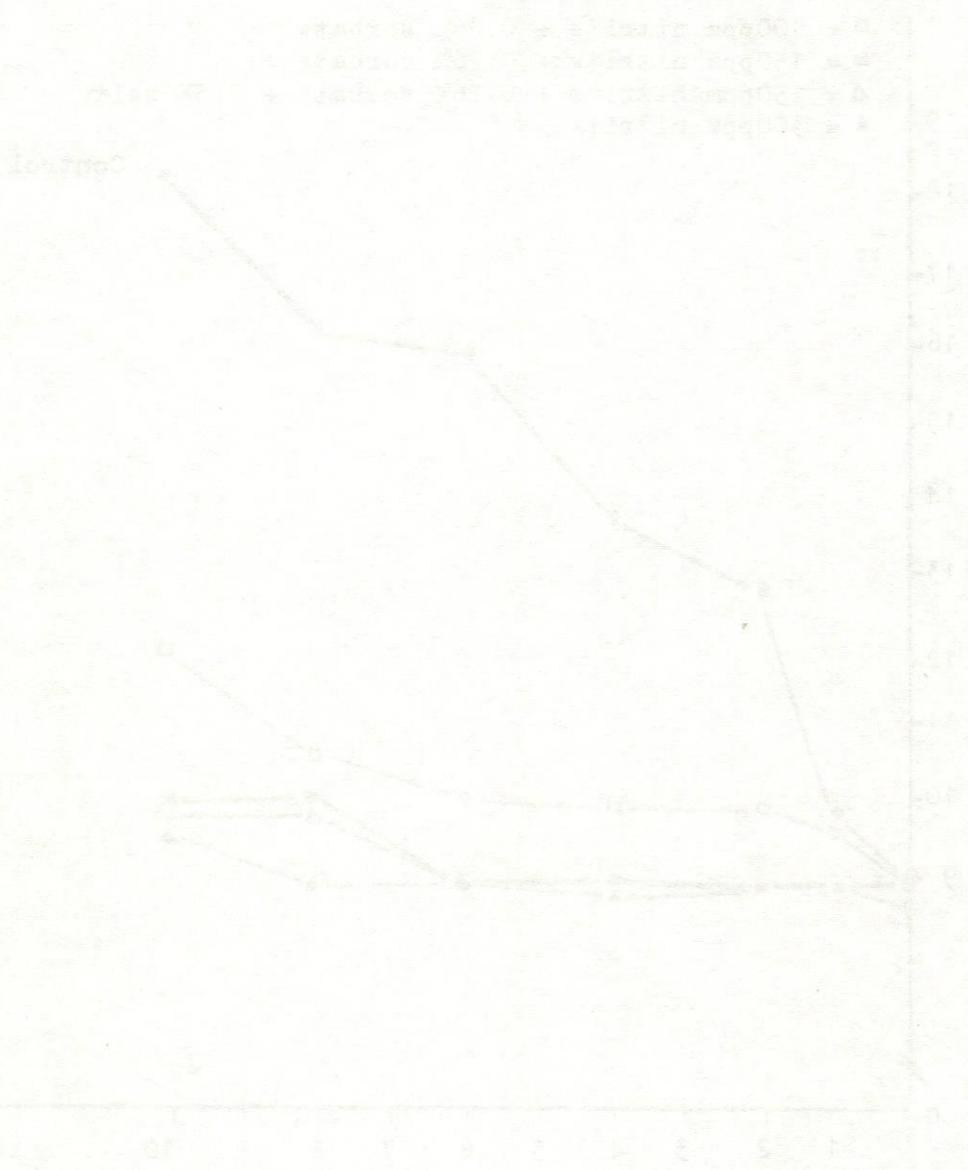


Fig. 2  $\text{Log}_{10}$  of total plate counts/g of sample versus days of storage at 4-5°C. The meat was formulated with the following additions: none, 100ppm nitrite plus 0.26% sorbate, 150ppm nitrite plus sorbate, 150ppm nitrite plus sorbate plus 2.5% salt, or 300ppm nitrite. All points represent the average of 6 plates.



Percent of total cells surviving in culture

Figure 1. Effect of 1000 rads on the survival of cells in culture. The cells were irradiated with the following radiation dose: 1000 rads. The cells were then cultured in the presence of 10% serum. All data represent the average of 3 plates.