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Progress Report Ozone Pretreatment

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**Progress Report
Ozone pretreatment**

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1. Introduction

Ozone can be used to improve quality and shelf-life of, for example, meat and poultry. Also the microbiological quality of waste water can be improved by an ozone treatment.

In order to improve the quality of red meat, ozone pretreatments will be performed and the quality will be assessed using objective measurements.

Goal of the project

Development of an optimal ozone-pretreatment in order to increase the quality and shelf-life of red meat.

2. Material and Methods

Meat

Grinded meat (beef) was purchased from a local butcher. The meat was not treated with any compound that influences the color or quality.

Experimental set-up

The experimental set-up is shown in figure 1. The meat (appr. 50 gr) was placed on a glass Petri-dish in a glass jar (0.5 L) with an inlet and outlet. The jar was flushed with appr. 4 L of (ozone-containing) gas mixture.

The ozone generator was: trailigaz ozone generator

The destructor was: hankin ozolat TM

The destructor was: ozone analyzer BMT 961 (BMT, Berlin)

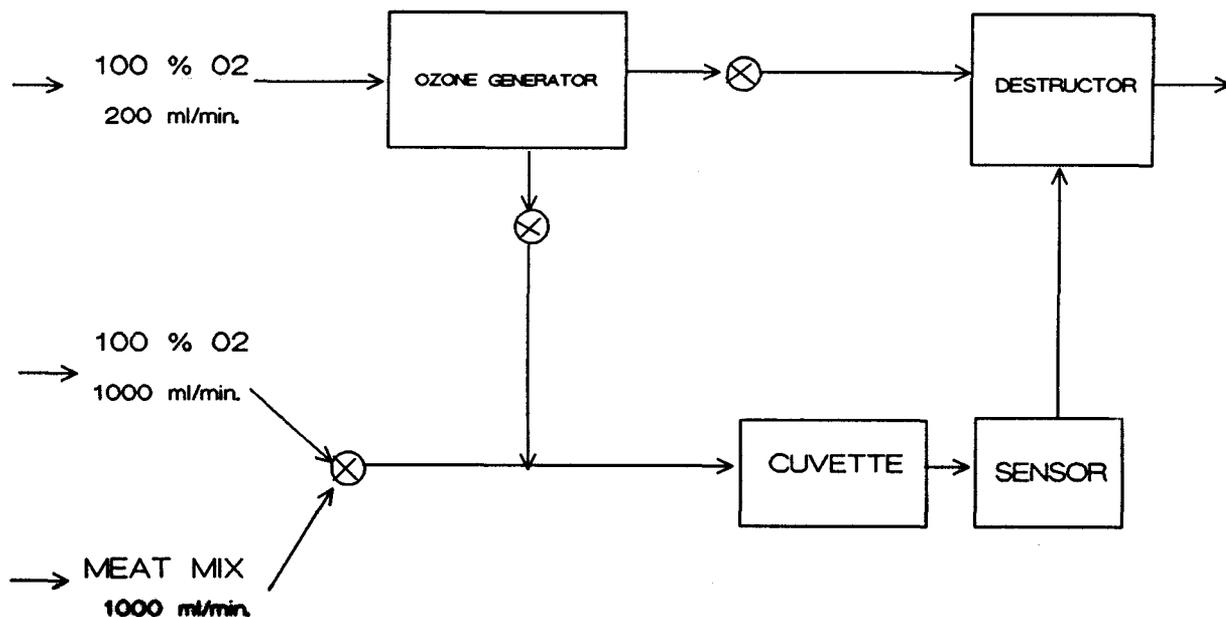


Fig.1 Experimental set up of the ozone-treatment

Treatment

Ozone-treatments were as follows: 0, 100, 300, 1000, 3000 and 10.000 ppm ozone, (generated in 100% O₂) thereafter mixed in 100% O₂ or in Meat-Mix (70% O₂/30% CO₂). After flushing, the jars were closed and placed at 5°C in a stainless steel container with either 70% O₂/30% CO₂ or 100% O₂ in order to prevent possible changes in concentrations due to diffusion from the jars into the surrounding atmosphere.

Quality determination

At time 0 the color was measured using Computer Image Analysis, a device capable of objective color measurement. The system was routinely calibrated with red and green color charts. At days 7 all the samples were measured. The Total Colony Forming Units (CFU) were determined according to standard methods. Briefly, a sample of 25 g was homogenized in buffer medium (1:10 buffer dilution). Several dilutions were made (100, 1000 and 10000) and plated onto Plate Count Agar (PCA from Oxoid). The Petri-dishes were incubated at 25-30°C after which the colonies were counted. The Lactobacteria were determined according to standard methods. Briefly, a sample of 25 g was homogenized in buffer medium. Several dilutions were made and mixed with De Man, Rogosa, Sharpe Agar (MRSA) + delvocyct (Oxoid agar). The Petri-dishes were incubated at 25°C after which the colonies were counted.

3. Results

EFFECT OF 100 % OXYGEN ON OZONE TREATED MINCED MEAT

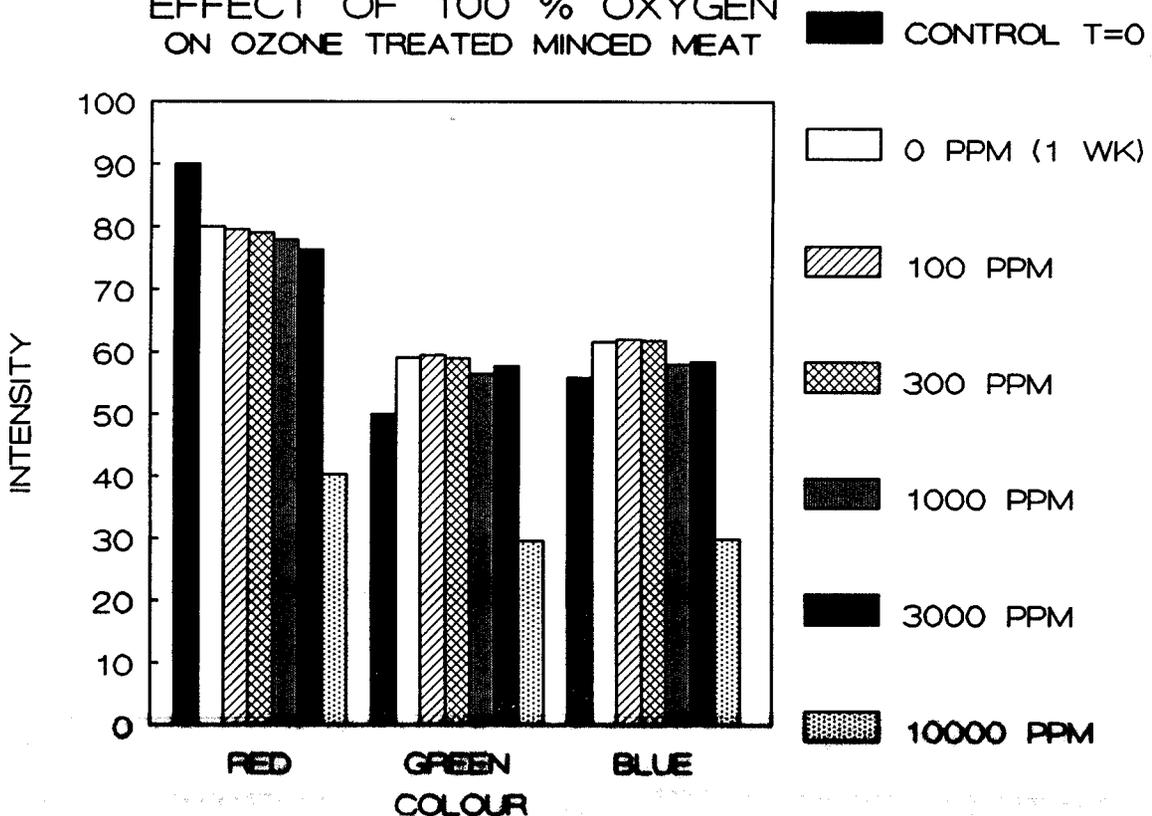


Fig.2 Effect of ozone, mixed with 100% O₂ on colour of minced meat, determined after 7 days stored at 5°C.

The effect of several ozone concentrations (generated in 100% O₂ or in MM) on the color is shown in figure 2 and 3.

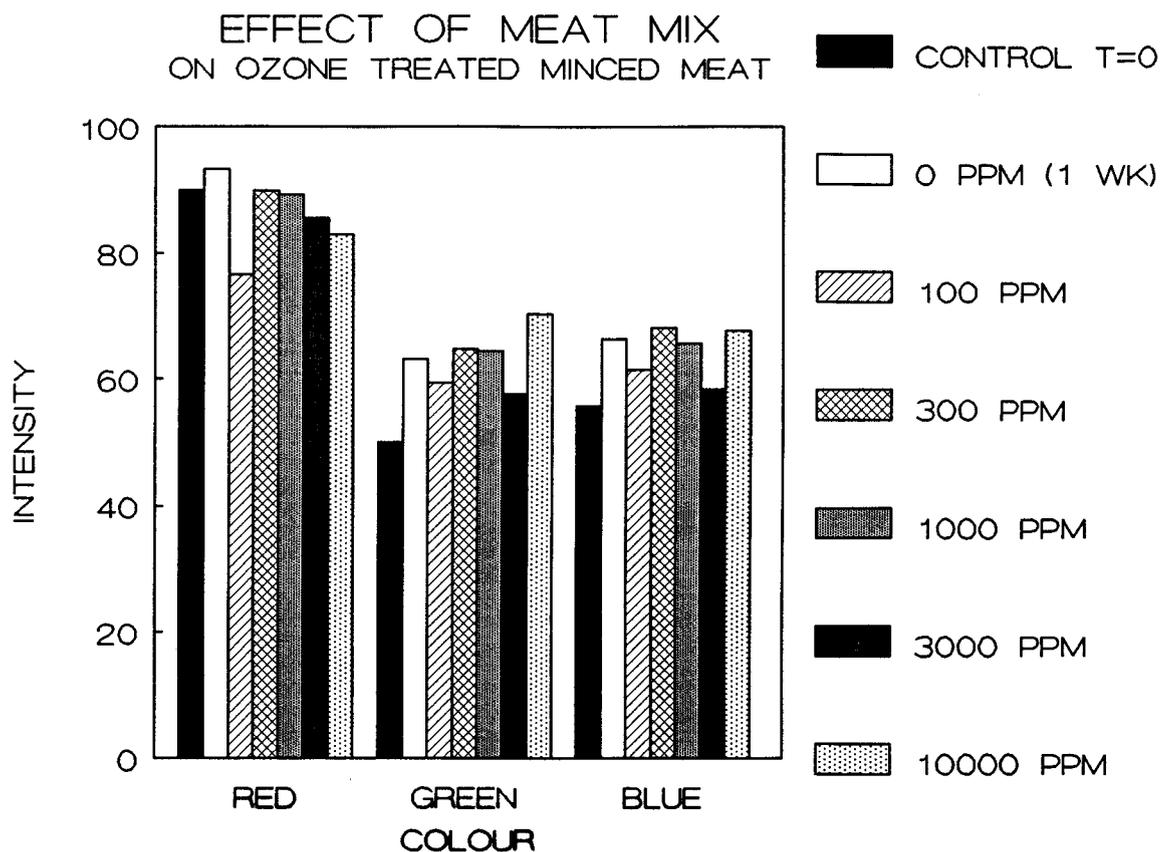


Fig. 3 Effect of ozone, mixed with Meat Mix, on colour of minced meat, determined after 7 days stored at 5°C.

The general trend, for ozone mixed with 100% O₂, is that at day 0 the red value is the highest. 7 days later it decreased. For all treatments the color remains similar.

The red, green and blue values did not change significantly in the meat-mix, comparing day 0 and day 7. However, there was no effect of the ozone, except for the 10,000 ppm treatment. This affected the color negatively. Visually the color got more green.

Using a green index (a calculated value from the original Red, Green and Blue data) it can be concluded that this value was increased at day 7 (compared to day 0). But again there was no effect of the ozone-treatment (figure 4).

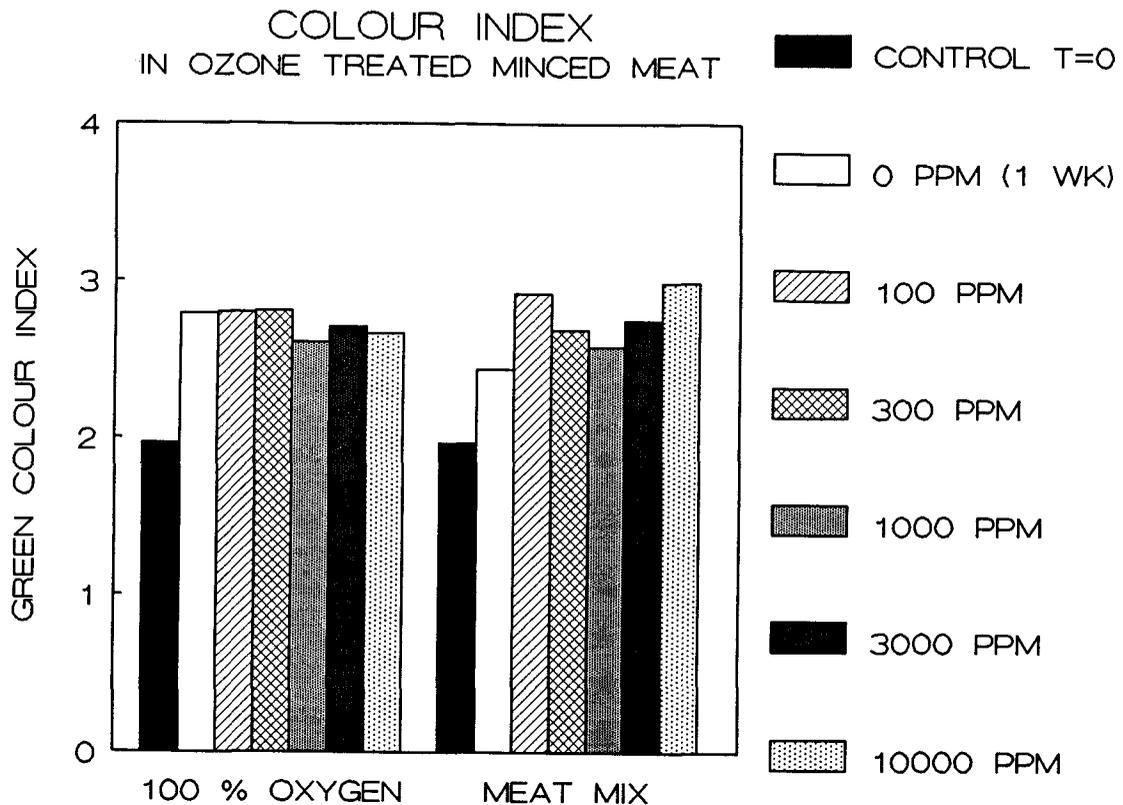


Fig. 4 Comparison of colour of minced meat, indicated as a green colour index, treated with several ozone concentrations.

The total aerobic count at day 0 was low. Within 7 days it increased till $10 \cdot 10^8$ CFU. However, there was no effect of the ozone treatment (figure 5 and 6). The total CFU was similar for all the ozone treatments. Meat Mix reduced the total CFU with about a factor 10.

The lactic acid bacteria were not affected by the ozone: all the treatments gave almost identical counts. Meat Mix did not show any effect in reducing the CFU of lactic acid bacteria, comparing with 100% O₂.

COLONY FORMING UNITS/g X 10E8

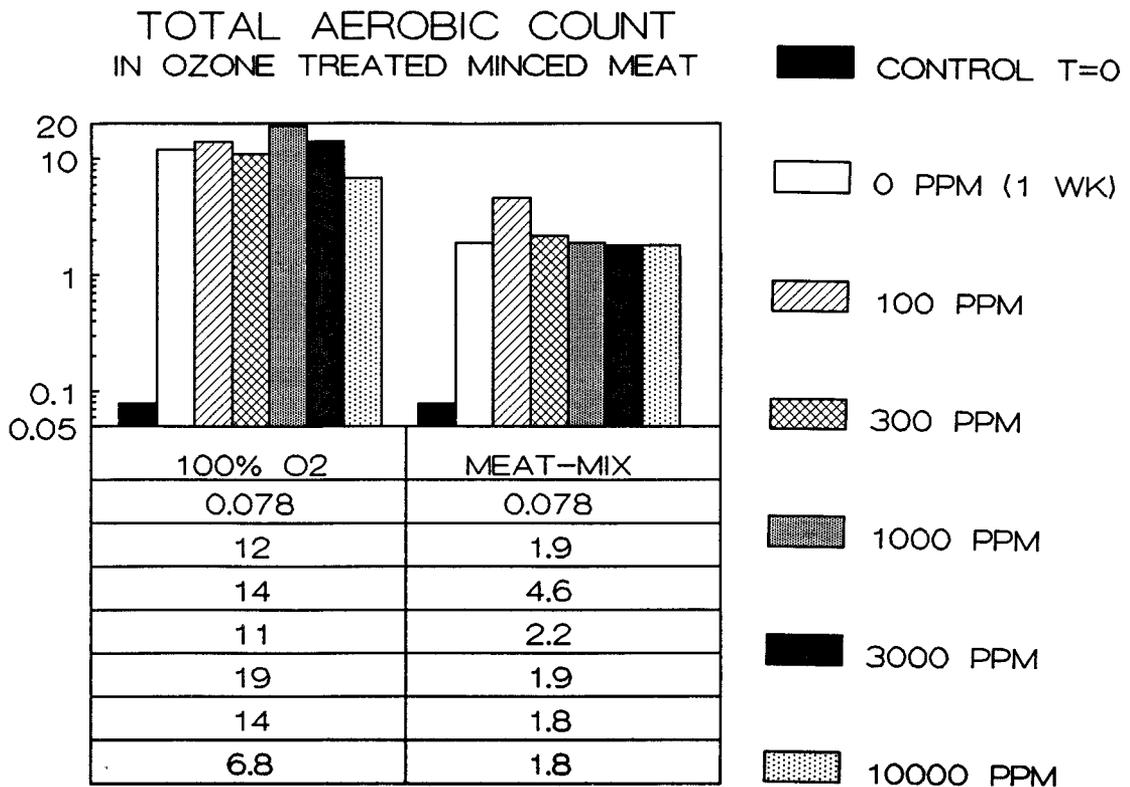


Fig. 5 Total aerobic count of meat, treated with several ozone concentrations, determined after 7 days, stored at 5°C.

COLONY FORMING UNITS/g X 10E7

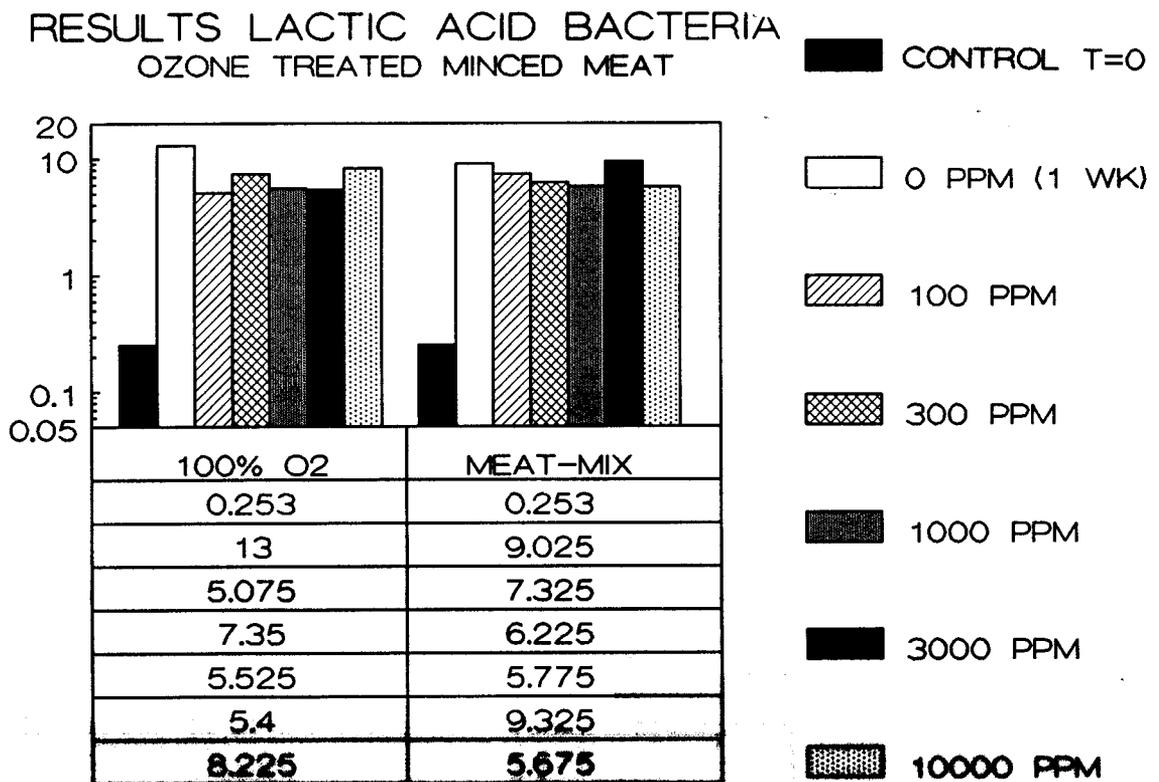


Fig. 6 Total count of lactic acid bacteria on ozone treated minced meat, determined after 7 days, stored at 5°C.

4. Discussion

Ozone pretreatment (several concentrations) and subsequent storage of grinded meat under pure O₂ or Meat Mix did not affect color, except for 10000 ppm ozone which influenced the color negatively, or microbial count. Since the ozone does not penetrate the meat there will only be an effect on growth of micro-organisms on the surface. Since we determined the total counts of a sample from inside and outside (whole part of meat), it could not be expected that the CFU number should be influenced significantly.

In order to answer the question whether an ozone-pretreatment can retain color under oxygen-free conditions, a follow up of the experiments is suggested.

5. Follow up experiment

- 6 concentrations of ozone (0, 100, 300, 1000, 3000 and 10000 ppm) generated in 100% O₂ will be applied to grinded meat (beef)
- contact time (ct) with the meat 15 sec (if experimentally feasible) or 4 minutes
- storage (sc) of the meat in 30% CO₂/70% N₂, or 80% CO₂/20% N₂ or in normal air, at 5°C during 7 days and possibly longer (depending on effect on color)
- this leads to: 2 (ct) * 6 (conc) * 3 (sc) * duplo = 72 treatments
- reference: meat stored in MM (70% O₂/30% CO₂) at 5°C during 7 days and possibly longer (depending on effect on color)
- the treatment and subsequent storage will be performed in foil (delivered by AGA)

Quality determination:

- color using Computer Image Analysis at t=0 d and at t=7d (possibly longer depending on outcome)
- microbial countings only at t=0 d and at t=7 if the color is still red. The reference will be determined at t=7 d.