The use of Low-Oxygen, EcO_2 Controlled Atmosphere method, to control insects in sesame seed and dried Figs from Greece

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ABSTRACT

The international industry is under high pressure to seek a preventive method to control insects in food commodities that does not lead to any quality reduction of the products. Especially the organic food industry is seeking for an effective method that also does not leave chemical residues.

The EcO_2 Controlled Atmosphere treatment (CA) is known and used worldwide by more and more companies and is one of the most effective method to control insects in all stages of development in food commodities, without using toxic chemicals and without negative effect on the quality of the products. CA is currently used to control insects in sesame seed from Greece. Both conventional as well as organic sesame seed is treated with Controlled Atmosphere. The CA method used is based on low-oxygen in combination with increased temperatures (e.g. 35° Celsius). To proof the effectiveness of this method, an experiment was conducted by controlling *Tribolium* and *Sitophilus* (Greek origin) in Sesame Seed and Dried Figs.

INTRODUCTION

The objective of this experiment was to proof the effectiveness of CA during exposure to sesame seeds and dried figs to control the applied insects Tribolium and Sitophilus.

The experiment was carried out in one of the EcO_2 facilities in Antwerp (Belgium), where sesame seeds and dried figs from two different Greek companies where treated. Extra thermometers and oxygen sensors where placed in various spots to control the parameters of the experiment. After treatment the experiment showed a 100% control of insects in all stages.

After proofing the effectiveness of this experiment, the Greek company decided to construct 6 Controlled Atmosphere chambers (5 of 147 m^3 and 1 of 294 m^3) at their factory in Thessalonica for the treatment of their yearly volume of sesame seeds.

MATERIALS & METHODS

Equipment

The experiment was conducted in a climate controlled room, constructed by the company EcO_2 and connected to the EcO_2 converter system, creating the Controlled Atmosphere. The facility is located in Antwerp, Belgium. The volume of the room is 310 m3. The experiment products and insects species were placed inside the room after which it was

hermetically closed. Inside air is circulated through the EcO_2 converter which creates low-oxygen air of < 1%. Inside room temperature was increased to 28 – 35 degrees Celsius for optimum insect activity. Extra temperature and oxygen sensors where used for extra data recording.

Products

Products of two different Greek companies where treated during this experiment; one pallet of sesame seeds imported from India and one pallet of sesame seeds from Greece and dried figs from Greece. All products came in normal packaging. The sesame seeds came palletized with external wrapping which was taken off the packaging (Fig. 1). The dried figs came in 2 boxes of 12 kgs each, commercially packed (Fig. 2).

Fig. 1. Pallets sesame seeds

Fig. 2. Boxes with Dried Figs

Insects

The experiment was performed using all developmental stages of a mixture of several pest species, originated from Greece (Table 1). Insects were placed in the pallets of sesame seeds (Fig. 3.) and in the two boxes of the Dried Figs. Test insects from the same species where hold at the Laboratory of AgroSpeCom for control (Fig. 4.).

TABLE 1: Insect species, stage, placement during experiment

Code	Insect	Stage	Placement
1	Tribolium	Larvae	Sesame company A
2	Tribolium	Larvae	Sesame company B
2	Tribolium	Larvae	ASC Lab
4	Tribolium	Eggs	Sesame company B
5	Tribolium	Eggs	Sesame company A
6	Tribolium	Eggs	ASC Lab
7	Sitophilus	Larvae	Sesame company A
8	Sitophilus	Larvae	Sesame company B
9	Sitophilus	Larvae	ASC Lab
10	Sitophilus	Eggs	Sesame company B
11	Sitophilus	Eggs	Sesame company A
12	Sitophilus	Eggs	ASC Lab
13	Tribolium	Adults	Sesame company A
14	Tribolium	Adults	Sesame company B
15	Tribolium	Adults	ASC Lab

16	Sitophilus	Adults	Dried Figs box 1
17	Sitophilus	Adults	Sesame Cargill
18	Sitophilus	Adults	ASC Lab
O	Tribolium	Eggs	Dried Figs box 2
OO	Tribolium	Larvae	Dried Figs box 2

Fig. 3. Insects placed in bag of Sesame Seeds


Fig. 4. Insect tubes

Treatment set up

The two pallets of sesame seeds were placed in the climate controlled room (Fig. 5 & 6.). One box of dried figs was placed on each pallet. Extra data recorders were placed at the following positions:

- 1 data logger per carton box of dried figs (applied in center of the product)
- 1 data logger per pallet sesame seeds (applied in center of pallet and bag of product)

After the treatment set up, the door of the climatic room was closed and treatment was started on-line via remote control.

The experiment was conducted in November 2007 which is winter season in Europe. Upon arrival of the experiment, temperature product was 11 °C. In 2,5 days the product temperature reached the ideal treatment temperature of 32 °C. Simultaneously during heating up of the products, the oxygen is decreased to < 1% in the room ensuring 100% control of the insects.

Fig. 5. Climatic Controlled Chambers


Fig. 6. Experiment set up

RESULTS

Low-Oxygen, Controlled Atmosphere treatment of the sesame seed and dried figs, experimental infested with Tribolium and Sitophilus, caused 100% mortality of all developmental stages. Total treatment duration (including heating and decrease of oxygen) was 5,5 days (fig.7). No negative effects on the quality of the products were observed. After the treatment all insect bioassays were kept at 25 °C for a period of 2 months, showing 100% mortality.

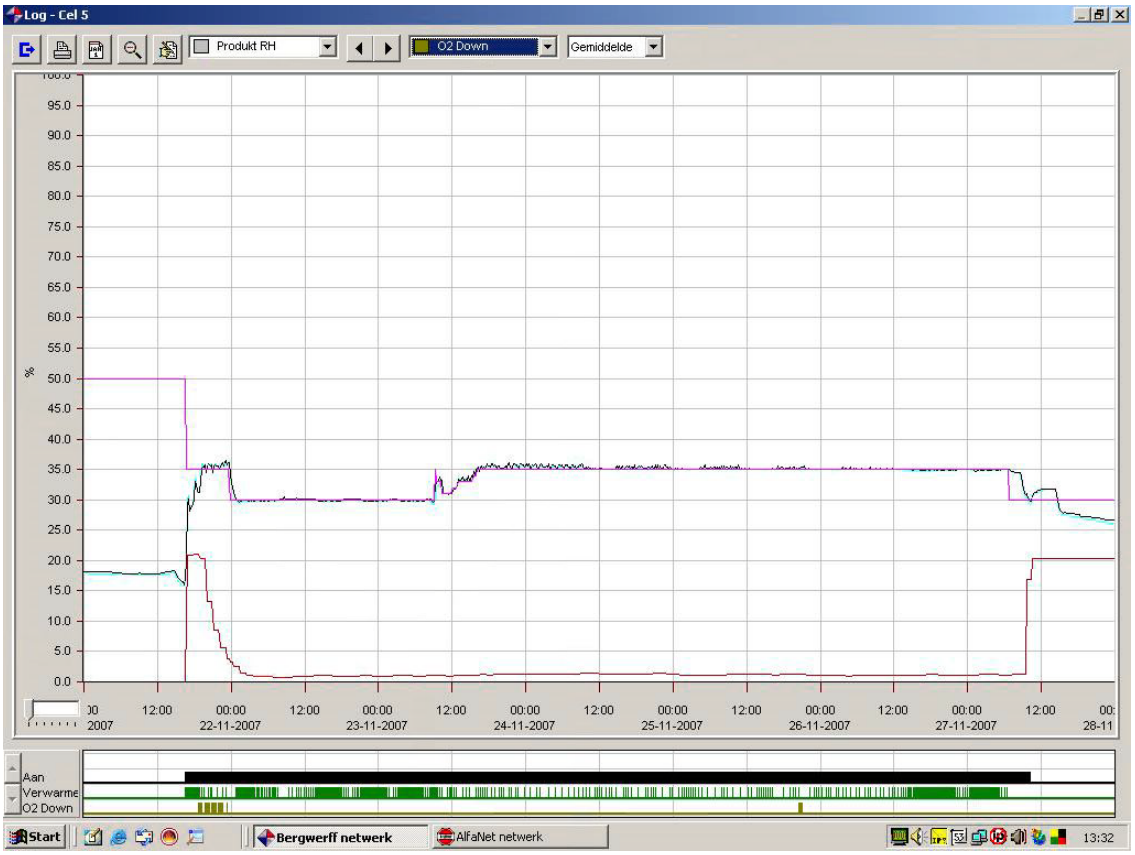

Fig. 7. Treatment graphic (black line = inlet temperature, blue line = room temperature, red line = O2 concentration, pink line = set point temperature)

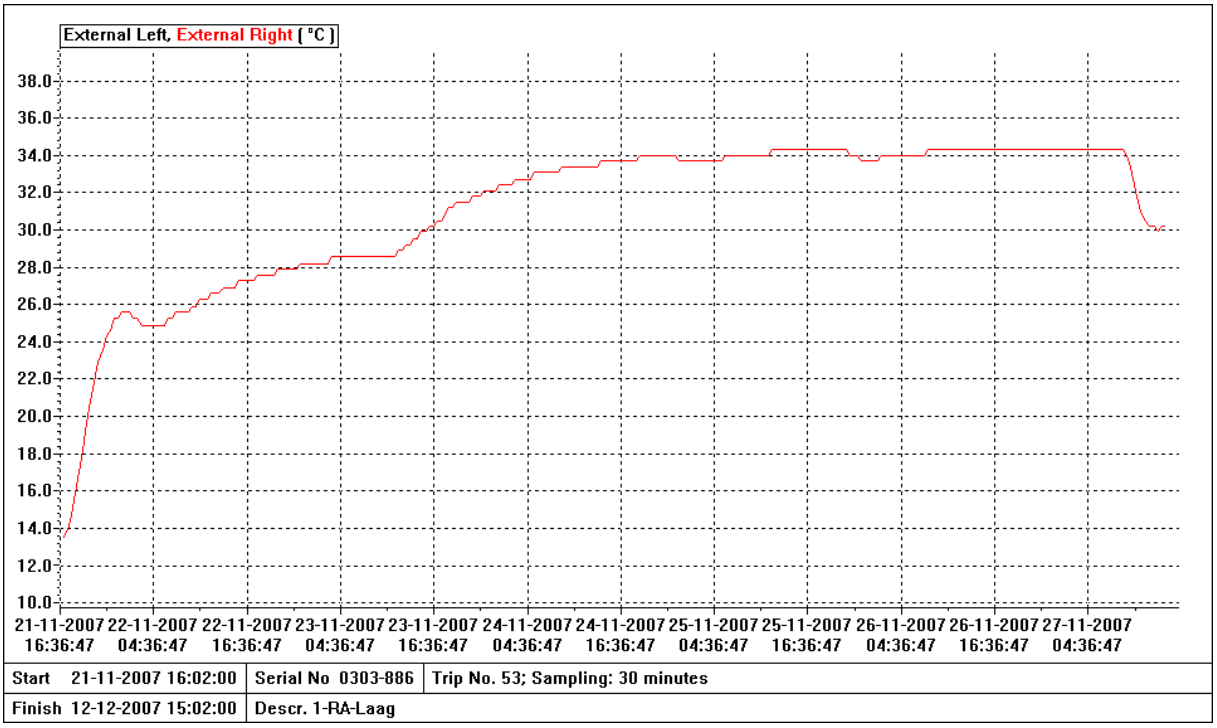

Fig. 8. Extra data logger in box of dried figs

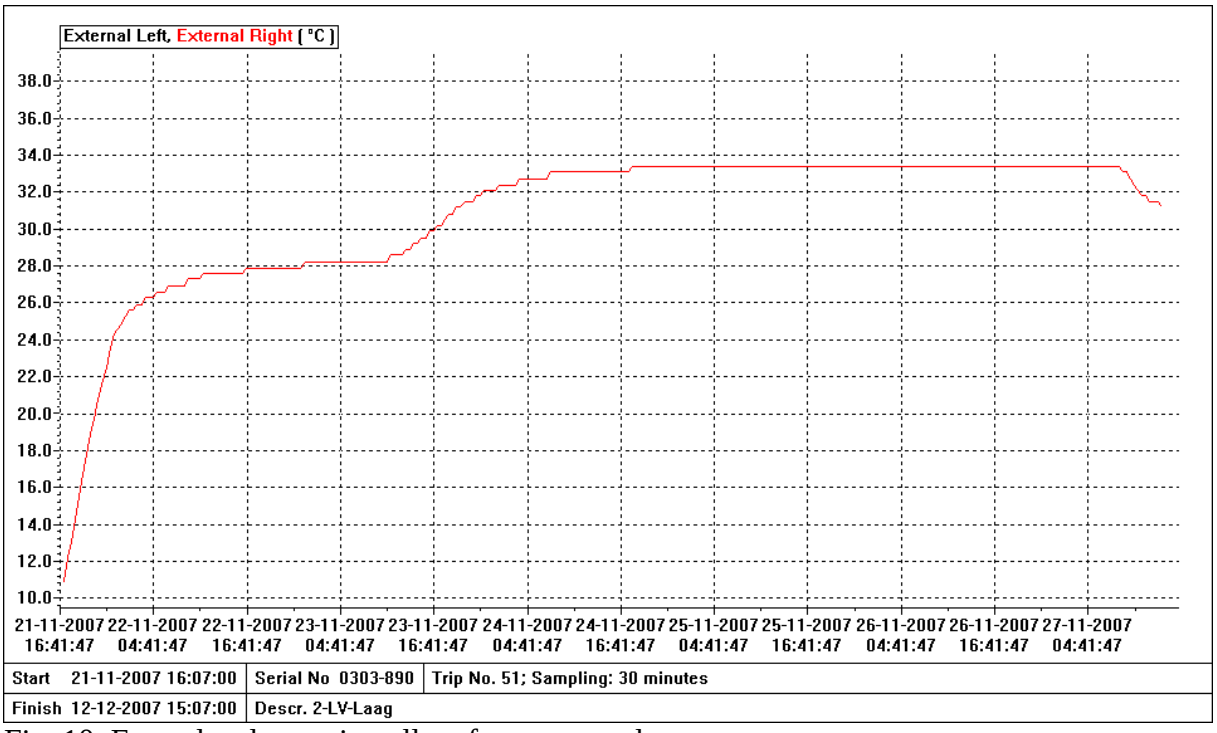

Fig. 10. Extra data logger in pallet of sesame seed

CONCLUSIONS

The use of Controlled Atmosphere has several advantages towards the existing methods for chemical insect treatments on products:

- Insects do not die inside the product. The insects try to escape the low oxygen by moving towards the chamber doors, thus moving out of the product.

- There is no use of insecticides and thus no residues
- The method is environmental friendly
- The system is used without waiting for a fumigator
- Each treatment is followed by an internationally known certificate
- No insect resistance is found with the use of Controlled Atmosphere
- There is practically no danger for the working personnel

Controlled Atmosphere treatments are currently carried out in facilities worldwide (14 countries) which totally have more than 105 treatment rooms.