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Study on Ozone Treatment for Vegetables

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Abstract
Ozone or trioxygen, is a triatomic molecule, consisting of three oxygen atoms. It is much less stable than the diatomic oxygen (O_2). Ozone is one of the more powerful oxidants that quickly decompose to diatomic oxygen (O_2), while reacting with targeted organic matter or microorganisms having a strong capacity of disinfection and sterilization. It is a powerful germicide which destroys all class of bacteria and fungi, not allowing their development. Unlike other biocides agents such as chlorine, the time necessary to make the disinfection is lower. For this reason, it is very effective in destruction of chlorine resistant microorganisms due to a power of reaction of three thousand times superior to the chlorine, which turns it is a possible biocide agent, as much for the water treatment, like for the treatment of air and closed atmospheres. Ozone is a powerful antimicrobial agent that has numerous potential applications in the food industry because of its significant advantages over traditional antimicrobial agents such as chlorine, potassium sorbates, etc. The present study is focused on the ozonation of the surface disinfection of the fruit and the vegetable samples at various time intervals. It is aimed at the comparison of the effect of ozonation on the treated samples at various time intervals and thereby determining the suitable treatment time for each of the samples. ozone, triatomic molecule ,antimicrobial agents.
Keywords: ozone, triatomic molecule ,antimicrobial agents.

1. Introduction

In the food industry, eliminating harmful microorganisms and inactivating enzymes are important for food quality and also for public health. That is the reason why heat treatment is the most utilized method of stabilizing foods because of its capacity to destroy microorganisms and also to inactivate enzymes. However, since heat can alter the organoleptic properties of foods and diminish the contents or bioavailability of some nutrients, there is a growing interest in searching for methods that are able to reduce the intensity of the heat treatments needed for food preservation. In order to reduce the detrimental effects of heat treatment, non-thermal alternatives are being tried. One such non-thermal preservation technique is the ozone treatment.

Ozone is a very interesting gas, colourless at room temperature and has a very distinctive smell and that's why its name was derived from the Greek word ozein which means "to smell". Ozone, sometimes called "activated oxygen", such that the ozone contains three atoms of oxygen, which are electrically bound together. Unlike the stable oxygen we breathe (O_2), ozone is unsteady that the ozone itself decays back to normal oxygen so rapidly. Ozone is the second most powerful sterilizing agent in the world and its function is to destroy bacteria, viruses and odours in nature.

Because ozone is a safe, powerful disinfectant as well as the strongest commercially available oxidant, it can be used to control biological growth of unwanted organisms in products and equipment used in the food processing industries. Ozone is particularly suited to the food industry because of its ability to disinfect microorganisms without adding chemical by-products to the food being treated or to the food processing water or atmosphere in which food are stored.ozone is 52% stronger than chlorine, thus when bubbled through water, it provides a more effective sterilization than chlorine without any residual taste or smell.

2.Material And Methods

The raw materials that are employed for the study is cauliflower. The cauliflower is a compact, edible head of whitish undeveloped flower bud is yet another member of the cabbage family (Brassica oleracea); has a head (called a curd) of tightly packed white florets partially covered with large waxy, pale green leaves on a white-green stalk; some varieties have a purple or greenish tinge.

2.1 Steps Involved In Selection Of Raw Materials

The vegetable are selected such that they should be fully matured, devoid of bruises or blemishes and are of uniform size.

2.1.1 Pre-Treatment Of The Raw Materials

The vegetable that are to be ozonated as whole are sprayed with potable water to remove the adhering dirt. The liquid samples should be handled in sterilized containers and they must be filtered before the process of ozonation.

2.2 Methodology

2.2.1ozone Treatment For Washing Of The Vegetables

The vegetables that were subjected to the pre-treatment process are immersed in the air tight, treatment container containing clean water for ozonation. The water for washing should be ample enough for the quantity of the raw material taken and should be deeper enough such that the ozone diffuser should get immersed in it. The lid of the container is closed and the tube that carries ozone from the generator is inserted into the container through the hole in the lid of the container. The ozone generator is turned on and the ozone gas is bubbled in through the wash water and thus the process of washing commences. The treated samples are derived from the treatment container at a time interval of 5 minutes, for up to 20 minutes. Each of the sample, including an untreated sample is then subjected to testing methods including the Total Plate Count test for Bacteria, test for the presence of *E. Coli* and refrigerated storage by wrapping in a bag of polypropylene which is heat sealed. All the treated samples were compared with the untreated samples and also they are compared among themselves so as to optimize the best time limit that is required for the treatment of the particular product under study.

2.2.2. Refrigerated Storage Of The Ozonated Samples

Each one of the samples from all the treatments are packed in a bag of polypropylene that are heat sealed and are then stored at refrigerated condition to determine the time up to which the product remains fresh.

3.Results And Discussion

Ozone is one of the oxidants more powerful than they are known, and for this reason it has a strong capacity of disinfection and sterilization. It is a powerful germicide which destroys all class of bacteria and fungi, not allowing their development. The high chemical reactivity of ozone is related to its stable electronic configuration which impels to look for electrons from others molecules. During the reaction with other molecules, ozone is destroyed after the oxidation process and the oxygen atom is released without producing any harmful atmospheric pollutants. Also the process does not leave any residues in the treated samples.

This chapter deals with the results based on the microbial analysis of the ozonated samples for the presence of any potential microorganism before and after the treatment. The samples were also subjected to the sensory evaluation process for the better optimization of the treatment time for each sample under study.

3.1. Microbial Analysis For The Test Samples

The test samples were subjected to microbial estimation process which determines the presence of microbes by subjecting the samples to Total Plate Count (TPC) test and test for the presence of *E.coli.* The TPC is carried out at 37°C and the microbes are determined in Colony Forming Units.

MICROBIAL ANALYSIS FOR CAULIFLOWER

S. NO	SAMPLE DESCRIPTION	PARAMETERS	
		TOTAL PLATE COUNT AT 37°C	*E.COLI*
1.	Cauliflower (Untreated)	40 X 10^3 Cfu/g	02 X 10^3 Cfu/g
2.	Cauliflower (05 minutes)	14 X 10^3 Cfu/g	Absent X 10^3 Cfu/g
3.	Cauliflower (10 minutes)	Absent X 10^3 Cfu/g	Absent X 10^3 Cfu/g
4.	Cauliflower (15 minutes)	Absent X 10^3 Cfu/g	Absent X 10^3 Cfu/g
5.	Cauliflower (20 minutes)	Absent X 10^3 Cfu/g	Absent X 10^3 Cfu/g

In the case of TPC, initially it was found to be 40 X 10^3 Cfu/g and is absent soon after a treatment of 10 minutes. In the case of *E.Coli,* initially it was 02 X 10^3 Cfu/g and after a treatment of 5 minutes, it was found to be absent.

3.2. Sensory Evaluation For The Test Samples

Sensory analysis is a multidisciplinary science that uses human panelists and their senses of sight, smell, taste, touch and hearing to measure the sensory characteristics and acceptability of food products. There is no one instrument that can replicate or replace the human response, making the sensory evaluation component of any food study essential. Sensory analysis is applicable to a variety of areas such as product development, product improvement, quality control, storage studies and process development.

3.2.1.Sample Preparation

Samples for sensory comparison should all be prepared by a standardized method to eliminate the possibility of preparation effects.Sensory evaluation of the product was carried out to assess whether the product obtained gave satisfactory results when compared with the market products. The sensory analysis of the Cauliflower and the carrots were carried out using a 9 point hedonic scale. The panel consisted of 4 judges, who rated the sample from 1 to 9 according to the following criteria,

1. dislike extremely
2. dislike very much
3. dislike moderately
4. dislike slightly
5. neither like nor dislike
6. like slightly
7. like moderately
8. like very much

3.2.2sensory Evaluation Of Cauliflower After The Treatment

Sample A: Cauliflower is treated for 20 minutes and is salted and cooked for 2minutes.
Sample B: Cauliflower is treated for 15 minutes and is salted and cooked for 2minutes.
Sample C: Cauliflower is treated for 10 minutes and is salted and cooked for 2minutes.
Sample D: Cauliflower is treated for 5 minutes and is salted and cooked for 2minutes.
Sample E: Cauliflower which is untreated is salted and cooked for 2minutes.

SENSORY EVALUATION OF CAULIFLOWER AFTER THE TREATMENT

PANEL LIST	COLOUR					APPEARANCE					AROMA					FLAVOUR					TASTE				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
I	7	7	3	2	1	7	7	3	2	1	7	7	6	4	3	7	4	3	3	6	8	6	5	4	6
II	6	7	7	6	4	7	7	7	6	4	7	7	7	5	5	6	8	8	8	3	7	7	7	7	4
III	7	6	6	5	6	7	7	6	5	5	7	6	7	6	6	7	6	6	6	5	6	5	6	6	5
IV	7	7	7	5	5	7	5	6	6	5	5	7	7	5	6	7	8	8	7	6	7	7	6	7	5

4. Summary And Conclusion

The objectives of the work were to study the optimum treatment time required for the disinfection of the microbes on the surface of the vegetables that are subjected to the ozone treatment. The sample that were subjected to the ozone treatment is Cauliflower.To determine the effects of ozone treatment, the samples were subjected to ozone treatment at different time intervals (Vegetable sample-5, 10, 15 and 20 minutes;). The treated samples were then subjected to microbial analysis by Total Plate Count method and Test for the presence of *E.Coli* in the treated samples. The vegetable samples that are treated were subjected to sensory evaluation.

The results obtained from the microbial analysis indicates that the optimum treatment time for the cauliflower sample was 10 minutes; From the results of the sensory evaluation of the treated vegetable samples, it was concluded that the products were well accepted.The study also reveals that when the treated samples were wrapped in a polypropylene pack and refrigerated, the vegetable samples can be stored for about 15 days that retains its freshness and the liquid samples exhibited no offensive changes in odour and colour.

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