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Studies on the shelf life of orange juice preserved by Pasteurization method

O.O. Olowoyo*, O.F. Oludare, F.A. Akinyosoye, and F.C Adetuyi.

Department of Microbiology, Federal University of Technology, P. M. B. 704, Akure, Nigeria

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ABSTRACT Juice was obtained especially from ripe oranges harvested from the same tree. One portion was pasteurized at 63^{o}C for 30 minutes. Both the pasteurized and unpasteurized portion were allowed to ferment for 14 days. Daily temperature, pH and microbial counts were taken for the whole fermentation period and the microorganisms isolated identified as *Bacillus, Lactobacillus, Micrococcus, Saccharomyces* and *Penicillium spp.* No appreciable temperature fluctuations were noticed in both juices during fermentation but their pH with initial value of 3.50 both fell to 3.30 (pasteurized juice) and 3.40 (unpasteurized juice) after 14 days. Initial bacteria and fungal counts were zero for the pasteurized juice while the unpasteurized juice gave 4.0 x 10^5 cfu/g and 2.0 x 10^5 cfu/g respectively. The unpasteurized juice showed steady growth in its microbial population while no growth was observed in the pasteurized juice until the seventh day. The growth in the pasteurized samples can be considered negligible when compared to the equivalent day of fermentation for the unpasteurized juice.

Key Words: Orange (*Citrus sinensis*); Orange juice; Food preservation; Pasteurization.

Introduction

Orange (*Citrus sinensis*) belongs to the family *Rutaceae* and a single genus citrus contains the most important species such as sweet, bitter, lemon, lime, grapefruit and shaddok. Citrus fruits are appreciated for their 'fruity' sweet and refreshing qualities. Orange is rich in sugar, protein, cellulose and vitamin C. They are almost wholly used breakfast or desert fruit. The juice may be extracted commercially by pressing cut halves of the fruit and used in squaches and cordials or flavouring (Kochlar, 1986). The main industrial use of citrus fruit is the production of fruit juice. These may be concentrated and frozen before export to lower the cost of production. Foods to be preserved usually carry spoilage organisms with them, which should be reduced, as much as possible. Food harbour 'heavy load' of organisms, fungi are the most common cause of spoilage. Pasteurization is one of the methods of food preservation and the aim of food preservation method is to keep out microorganisms by maintaining unfavourable conditions for their substenance and growth. This study is aimed at assessing the keeping quality of pasteurized orange juice stored for 14 days at ambient temperature and relative humidity with no addition of preservation agents as usually practised in the industry.

*To whom correspondence should be addressed.

Materials and Methods

Ripe fresh oranges (*Citrus sinensis*) used for this study were harvested from the same tree in a farm within the Campus of the Federal University of Technology Akure.

Orange Juice Preparation

Washed oranges were cleaned with 70% alcohol and rinsed with sterile water to reduce the contaminant on them. Aseptically the oranges were peeled and juice squeezed into sterile a flask. 600ml each of the juice was measured out into sterile fermentation vats. A thermometer was inserted into the vat to measure the temperature daily for 14 days. One portion of the juice was pasteurized at 63^{o}C for 30 minutes.

Microbial Examination of Samples

Inoculum was drawn from both pasteurized and unpasteurized orange juice daily up to 14 days and investigated for the presence of microorganisms. Serial dilution up to 10^5 factor was done and inoculated into sterile plates of Nutrients Agar (NA) and Potato Dextrose Agar (PDA). Plates were incubated at room temperature for 24 hours (NA plates and 3-5 days (PDA plates) for colony fermentation. Contents of colony were expressed as cfu/ml. Isolates were identified using the methods of Holt *et al.* (1986) for bacterial and Barnet and Hunter, (1972) for fungi.

pH Temperature Determination

The pH of the juice was taken daily using Jenway pH standardised with appropriate buffers. The temperature was daily noted on the inserted thermometer.

Results and Discussion

The microbial count of both pasteurized and unpasteurized orange juice is as shown in Fig. 1. No growth was observed from day 0 to day 6 in the pasteurized juice. The heat to which the juice was subjected led to the removal of the microorganisms. Olutiola *et al* (1991) noted that sour or bitter wine was associated with spoilage microorganisms and subjected the bottled wine product to boiling (50^{o}C -60^{o}C) for a short period to kill the undesirable Microorganisms without damaging the flavour of the product. Pasteurization is an easy and safe means of killing the common bacterial contaminants in fruit juice. This process involves heating of the orange juice at 63^{o}C continuously for 30 minutes or at 72^{o}C for at least 15 seconds. At these temperatures most of the bacterial and other contaminants will be killed but not their spores (Rangaswani, 1993). When conditions become favourable, the spores germinate into vegetative cells.

Scanty growth was seen for 3 days from the seventh day which declined for bacterial as the pH decreased making the medium acidic for the growth of fungi. Viable colonies were observed and counted from the unpasteurized juice. The lag phase lasted up to the 3 days after which a sharp increase (the log phase) due to proliferation and multiplication of cells was observed especially on the fourth day. Adaptation of the contaminants had taken place and utilisation of the sugar present in the juice and other available nutrients and environmental conditions by the microorganisms explained the rapid increase in growth. The unpasteurized juice will continue to ferment leading to a decrease in the pH. The reduced pH indicates increase in acid production during storage. Decrease in bacterial population can be accounted for by the lowering of the pH, resulting in the medium being more acidic and unfavourable for the growth of bacteria while fungi proliferation increased.

It can therefore be deduced that pasteurized juice may be stored for two weeks or more; where storage is intended to last for a longer period, chemical additives such as SO_2 and Sulphate may be added for preservation. These additives control the growth of mould in order to extend the processing period of products such as grapes, cherries and other berry fruits.

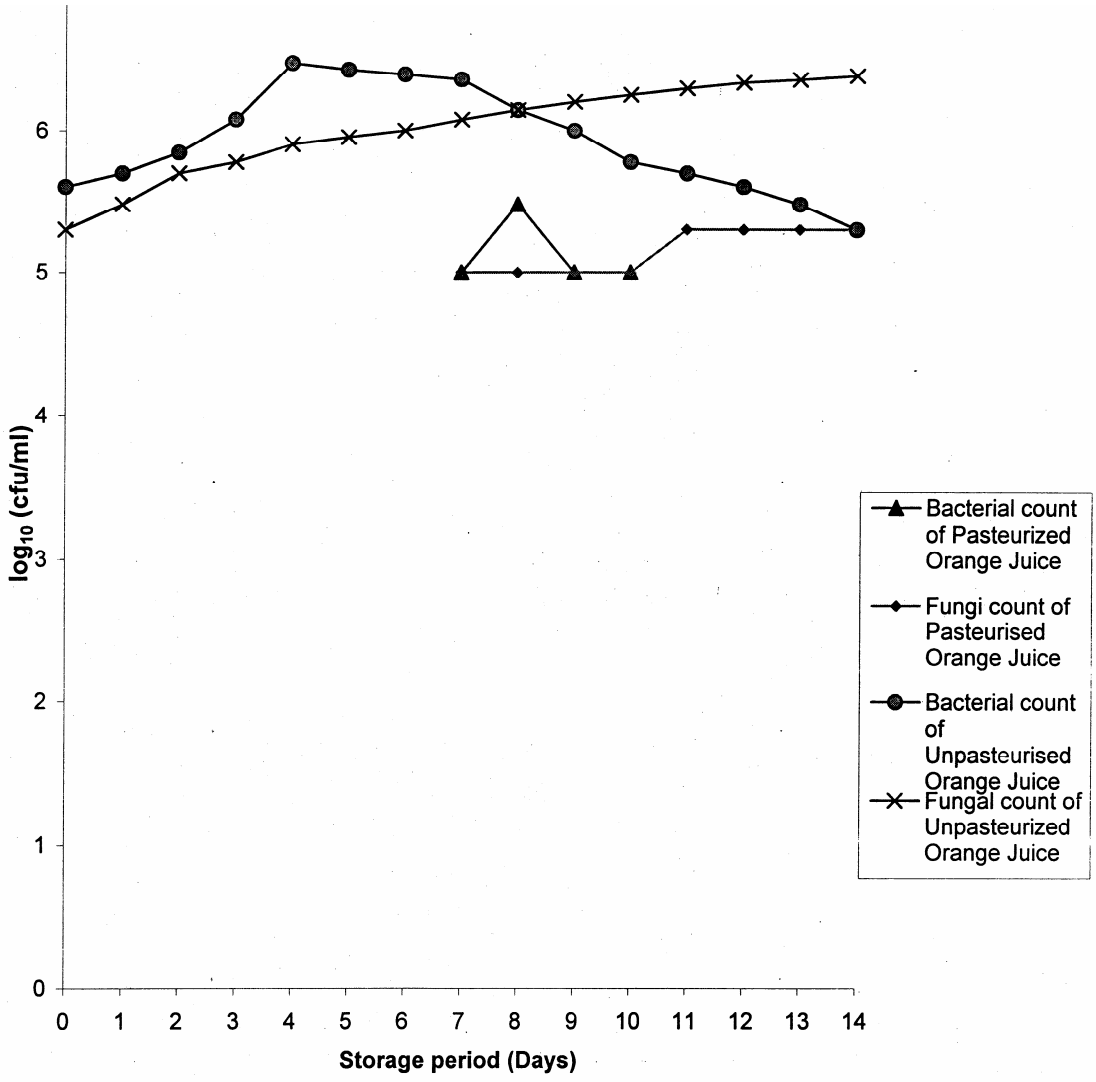

Figure 1: Microbial Count of Pasteurized and Unpasteurized Orange Juice (cfu/ml)

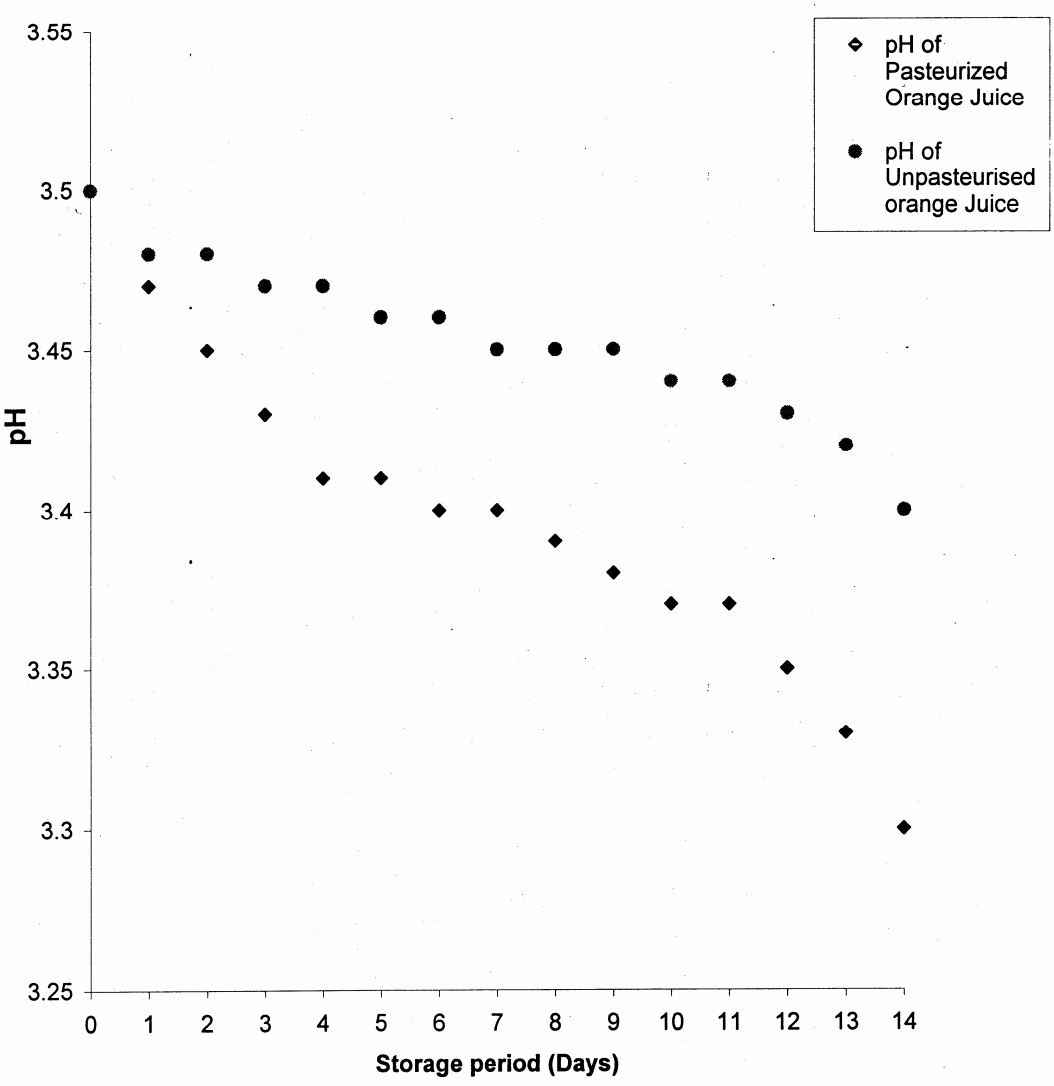

Figure 2: pH Changes in Pasteurized and Unpasteurized Orange Juice

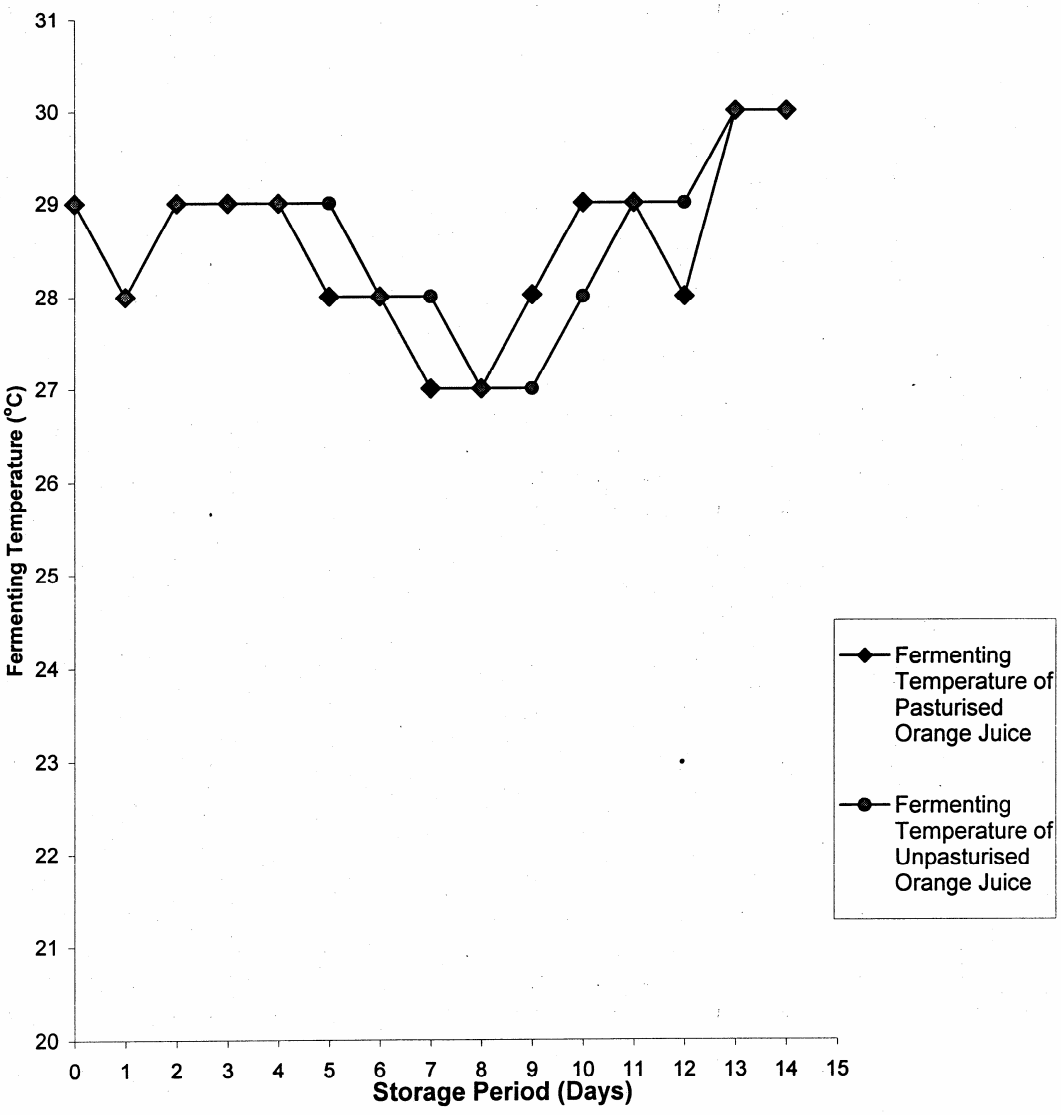

Figure 3: Temperature Changes in Pasturized and Unpasturized Orange Juice

Fermentation is a complex chemical transformation of organic substance brought about by the catalytic action of enzymes, either native or elaborated by microorganisms fermenting the sugar containing raw material (Pederson, 1971). Novellie (1981) reported that the great majority of fermentation in Africa are souring caused by lactic acid bacterial. The isolation of *Lactobacillus sp* among other isolates aided the fermentation process with the production of lactic acid which could be responsible for the reduction in the pH. *Saccharomyses sp* utilises sugar to produce alcohol. Okodugha and Obanu (1989) reported that a number of the items sold locally are highly contaminated with *Bacillus spp*. This high contamination is often attributed to the poor sanitary condition during processing. *Micrococcus* and *Lactobacillus spp* are normal flora of the body and may be introduced into juice upon contact with the hands or during processing. A source of contamination of the juice with *Penicillium sp* is the air. There are lots of mould spores in air especially in an untidy, unhygienic environment. Wind may carry the spores and blow them into the juice.

The results presented here indicate that pasteurized orange juice can be kept at ambient temperature for two weeks or more because no appreciable microbial population, which can initiate spoilage, was observed. Changes in microbial population were detected during the peak of count in the unpasteurized juice.

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