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Evaluate The Effect of Modified Atmosphere Packaging (MAP) on Physicochemical Properties and Microbial Population of 'Shahani' Dates.

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ABSTRACT

'Shahani' cultivar is the dominant date fruit in Jahrom region. Because of non-synchronized ripening and harvesting of the entire cluster, more yield of this cultivar is as Rotab. 'Shahani' Rotab in ordinary condition has the short storing ability and quickly affect with color change and microbial decay. In order to evaluate the effect of modified atmosphere packaging (MAP) on physicochemical properties and microbial population of 'Shahani' Rotab, this study was performed in Pars-Narang company depended on Tani group. For this purpose, 'Shahani' Rotab was placed into special containers of food packaging (PET) and was replaced their normal atmosphere with different percentages of O_2, CO_2 and N_2 by using of vacuum set and was sealed by impenetrable plastic to steam and gases and then was transferred to refrigeration with 0±1 °C temperature. In during about 6 months, were evaluated quantitative and qualitative properties and microbial population as monthly. Based on the results, in during of experiment period, relative humidity amount decreased, and TSS and pH increased but these changes were not significant. In all without-oxygen treatments, total microbial, mold and yeast population decreased from second month and became zero from the fifth month after that. Attentive to Rotab color, stability of container shape and sugar formation, CO_2 30% + N_2 70% treatment and storing in 0 °C after 6 months was recognized as the best treatment.

Keywords: Modified atmosphere packaging (MAP), Shahani Rotab.

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INTRODUCTION

Nowadays, widely is used MAP for enhancement of postharvest life and reduction of spoilage in many fruits and vegetables. In this system has been changed gas compound of fruit and vegetable package [1]. Increasing of CO_2 and decreasing of O_2 in package lead to reducing of respiration; reducing of production and sensitiveness to ethylene; reducing of tissue softening velocity; and reducing of fruits and vegetable decay [2]. Decreasing of O_2 or increasing of CO_2 in the package can be occurring indirectly by crop respiration or directly by entering of desirable concentrations of these gases. All living beings need for oxygen and die without it. Whereas in order to supply of respiration requirements of fruit and vegetable, their around air must be having a minimum concentration of oxygen. Excessive reduction of oxygen (less than 2%) leads to the growth of anaerobic microorganisms and crop fermentation [3, 4]. CO_2 prevents from growth of many aerobic microorganisms and molds. Increasing of CO_2 concentration lead to reduction of crop respiration and slowing of ripening and senescence process but its high levels can be lead to flavor change, loss water, reducing of enzyme activity and crumpling of package [5, 6, 7). Crumpling and deforming of a package is one of the limitations in packages containing materials with high moisture and for this purpose are used nitrogen gas in the package's air mixture. Nitrogen is a neutral gas that its existence in package leads to elimination of oxidation, reduction or prevention to microbial decay and preservation of crop package shape [7). Date fruit is one of the crops having high nutritive value. Date fruit for complete ripening must be passed from Khalal and Rotab stages to reach to Tamar stage (complete ripening) [8]. 'Shahani' is one of the dominant cultivars of date fruit in Jahrom region that need to 8 month period for complete ripening. Because of color and quality, 'Shahani' rotab has good market-demand but its steering is impossible for long periods except as frozen. Without freezing, after 10 days 'Shahani' rotab because of color change will not have a market-demand and by reason of high moisture affect by microbial decay and growth of mold and yeast [8]. Al-Redhaiman (2005) placed mature fruits of 'Barhee' cultivar in modified atmosphere storage (5, 10 or 20% CO_2) and 0 °C temperature and reported that placed fruits in 20% CO_2 condition had 7 weeks longer permanent and it had decayed and loss weight less than other treatments [9]. Achour *et al*. [10] reported that 'Dajlat Nour' date fruit had less water loss in packages containing 20% CO2 and 80% N2 in during of storing period and did not observe any microbial decay in them. Baloch *et al*. [11] in a research on 'Dhakki' date fruit reported that atmosphere containing additional N_2 significantly had an influence on postharvest life and quality than oxygen. Mortazavi *et al*. [12] reported that MAP for 'Barhee' date fruit on Khalal stage is more suitable than vacuum packaging. Because of information deficit on the influence of packaging type of 'Shahani' Rotab, this experiment was performed in order to evaluate the effect of MAP on physicochemical properties and microbial population of Jahrom's 'Shahani' Rotab.

MATERIALS AND METHODS

In order to evaluate the effect of MAP on physicochemical properties and microbial population and storage life of Jahrom's 'Shahani' rotab, this study was performed. For this purpose, 'Shahani' date fruits were harvested in rotab stage and was packaged in PET containers and was sewn by using the Basic and Speedy sets with Thermoform films and to

reach to design aims, atmosphere of packaging container was changed before sewing as below to follow:

1. 70% N_2 + 25% CO_2 + 5% O_2
2. 25% N_2 + 70% CO_2 + 5% O_2
3. 40% N_2 + 60% CO_2
4. 60% N_2 + 40% CO_2
5. 50% N_2 + 50% CO_2
6. 30% N_2 + 70% CO_2
7. 100% CO_2

Each above treatments had four replications and each replication had 50 fruits. Whereas storing temperature was one of the experimental factors, from each treatment was transferred to refrigerator by 0, 6 and -20 °C and was stored for 12 months. At the start of the experiment, randomly was measured relative humidity percentage, total soluble solid (TSS), pH and Microbial test (mold, yeast and bacteria) in 50 fruits and monthly mentioned characters and color change, container shape and amount of sugar formation. Finally, obtained results were analyzed by DOE method[11].

RESULTS AND DISCUSSION

Infection changes

Total microbial population

Based on first month results, the total microbial population was high but it was various in different treatments. The greatest microbial population was observed in packaging containing 60% N_2 + 40% CO_2 (Chart 4) and the least in packaging containing 100% CO_2 (Chart 6). In all treatments microbial population decreased from second month but in 100% CO2 treatment (Chart 6) increased. In third month microbial population reduced in all without-oxygen treatments but microbial population were about 10^3 in treatments of 25% N_2 + 70% CO_2 + 5% O_2 (Chart 1). In all treatments, the total microbial population reaches to approximately zero for fourth month (Charts 1 to 7). Microbial population in all packages decreased independent to storing temperature and placed packages in various temperatures had no significant difference.

Whereas, chemical disinfectant special by solutions is limited for rotab, MAP can be an effective help to elimination of infection. Decreasing of microbial population by MAP has been reported by other researchers [6, 7, 10] on date fruit and other crops that is according to the results of the present study.

PH changes

pH of rotab flesh was 6 at the beginning of the experiment. In during of the experiment was observed the changes in pH of rotab flesh and in all treatments increased so that in the end of the experiment was 7.5 and there was no significant difference between treatments (Chart 8).

Relative humidity changes

Relative humidity in the beginning of the experiment was 41.85%. In during of experiment relative humidity trend decreased but its amount was very paltry. This amount of all treatments was 0.06% (Chart 9).

TSS changes

TSS amount at the beginning of the experiment was 49.6%. In during of experiment TSS increased but its amount was no significant between treatments. At the end of experiment TSS amount was 50.6% (Chart 10).

Color changes

At the end of the experiment, the best color was observed in packages containing more than 70% CO_2 without oxygen stored in 0 °C temperature. In these packages rotab colors almost remained constant. In the stored treatments in 6 °C temperature rotab color became dark from the second month on and the stored treatments in -20 °C temperature had no desirable color after exiting from freezing. It has been reported that date fruit because of having carbohydrates, amino acids and phenolic compounds are susceptible to change of color affected by various oxidation and non-oxidation process [13] but placing it in MAP containing high CO_2 delay the trend of color change [14]. Obtained results from the present study is according to the findings of Baloch *et al*. [11] in relation to 'Dhakki' date fruit.

Sugar formation

Sugar formation is one of the problems in packaging of 'Shahani' date fruit. All stored treatments in -20 °C temperature had no sugar formation but in the stored treatments in 0 and 6 °C temperatures was observed sugar formation in packages containing more than 60% CO_2 from the third month on. There was the greatest sugar formation in a package containing 100% CO_2 (Figure 1).

Container shape

Container shape remaining constant is one of the important factors in market-demand of each crop. Container shape changed in store treatments in -20 °C temperature and also in the treatments containing more than 40% CO_2 and the worst container shape was observed in the treatment containing 100% CO_2.

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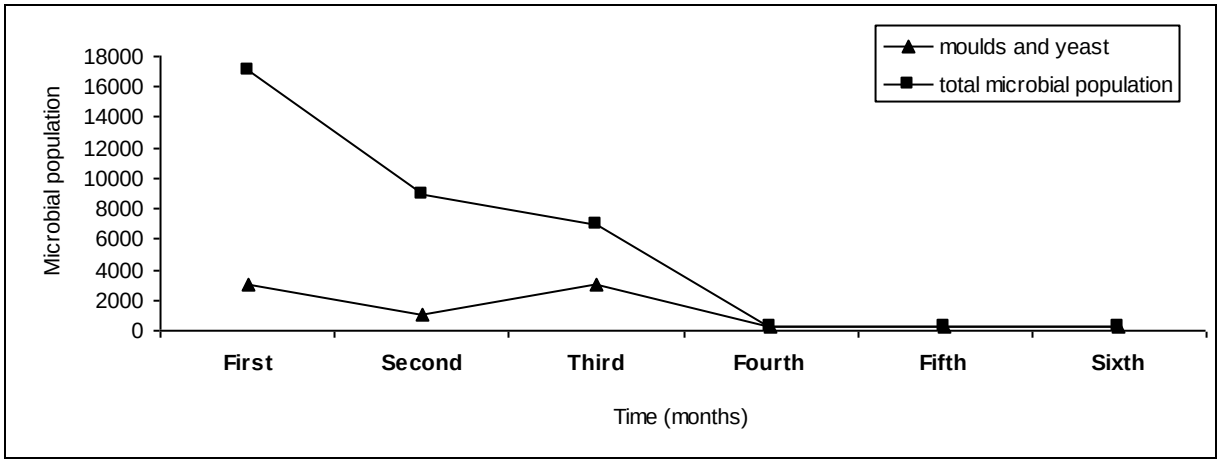

Chart 1- Infection changes in 'Shahani' rotab packaging containing 25% N_2 + 70% CO_2 + 5% O_2 in during of 6 months

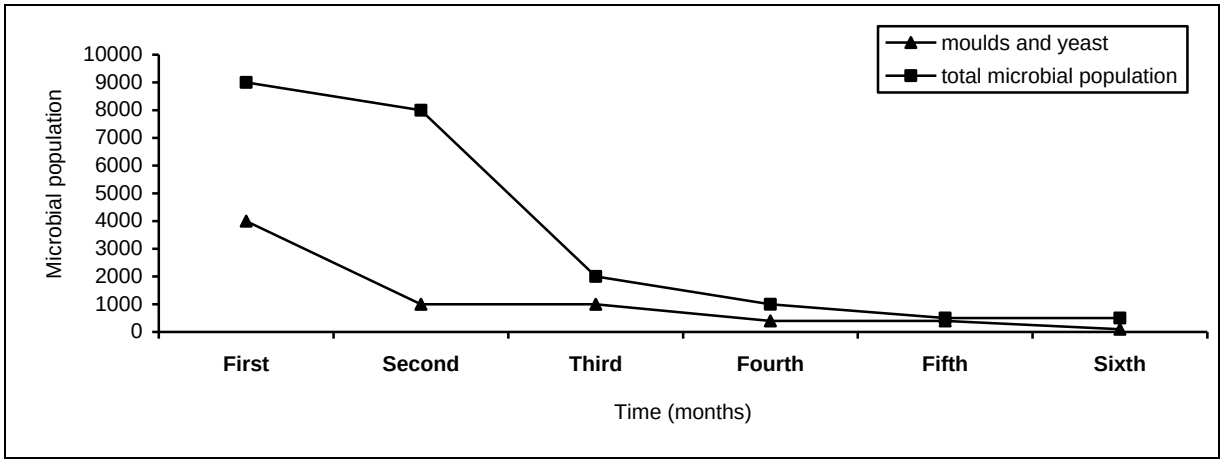

Chart 2- Infection changes in 'Shahani' rotab packaging containing 50% N_2 + 50% CO_2 in during of 6 months

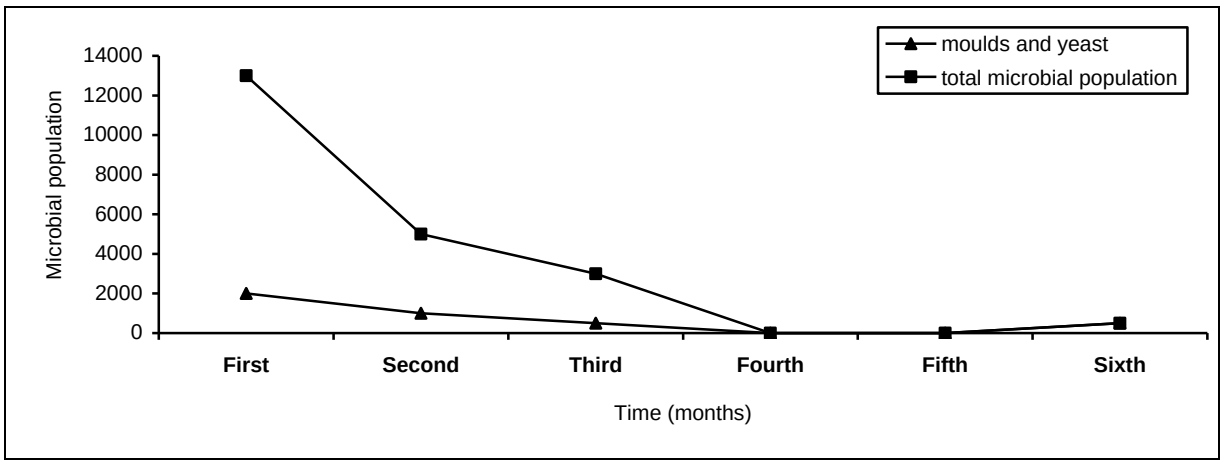

Chart 3- Infection changes in 'Shahani' rotab packaging containing 70% N_2 + 25% CO_2 + 5% O_2 in during of 6 months

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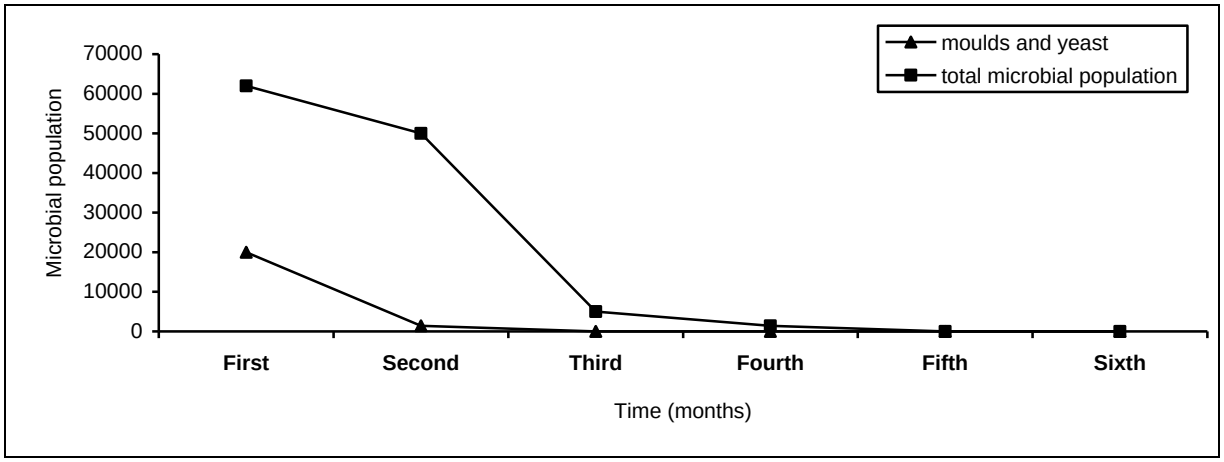

Chart 4- Infection changes in 'Shahani' rotab packaging containing 60% N_2 + 40% CO_2 in during of 6 months

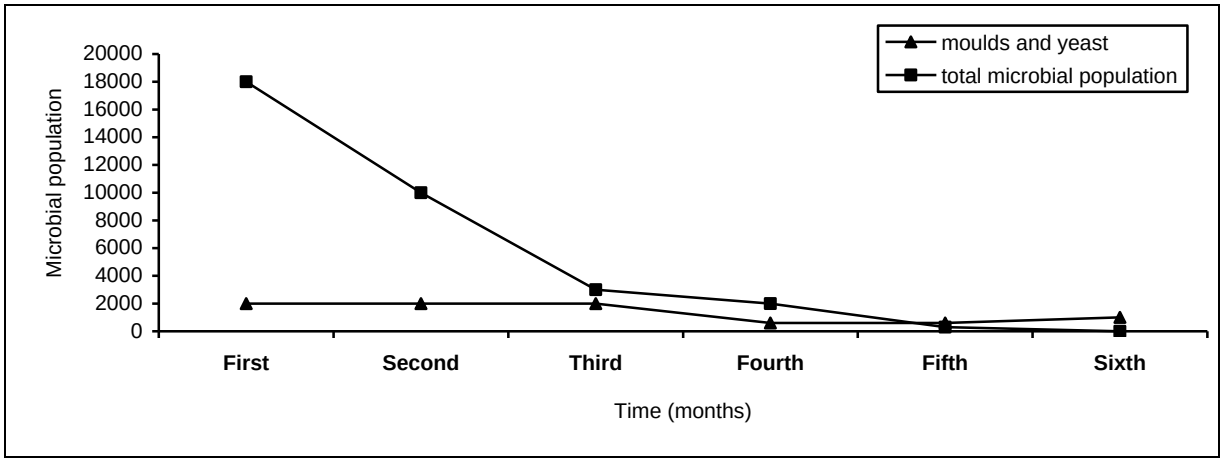

Chart 5- Infection changes in 'Shahani' rotab packaging containing 30% N_2 + 70% CO_2 in during of 6 months

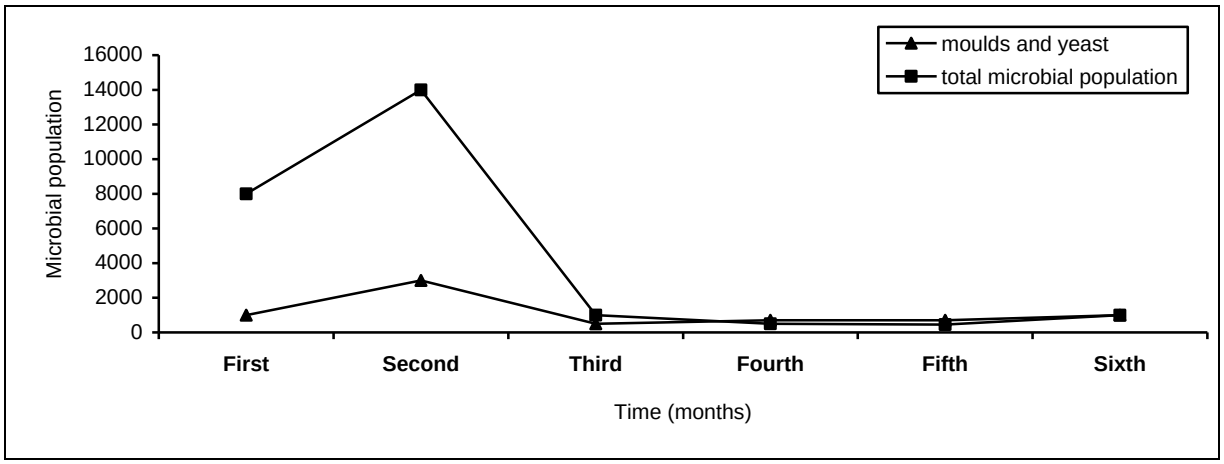

Chart 6- Infection changes in 'Shahani' rotab packaging containing 100% CO_2 in during of 6 months

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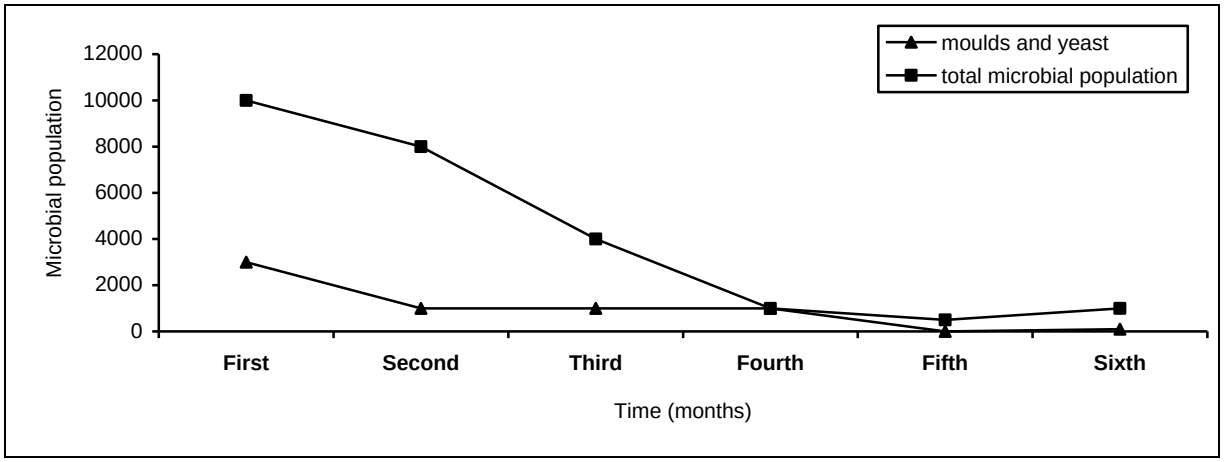

Chart 7- Infection changes in 'Shahani' rotab packaging containing 40% N_2 + 60% CO_2 in during of 6 months

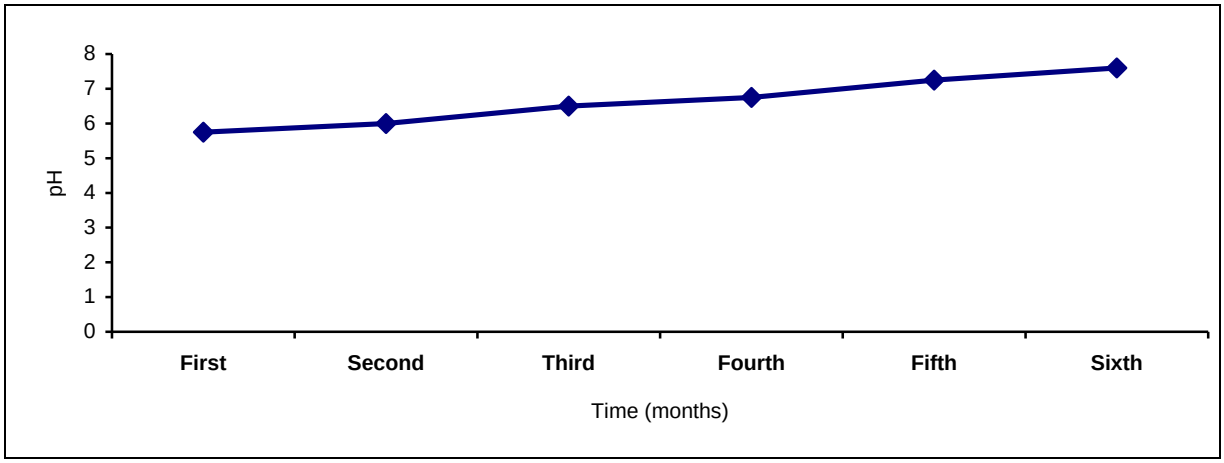

Chart 8- pH changes trend of 'Shahani' rotab flesh in MAP in during of 6 months

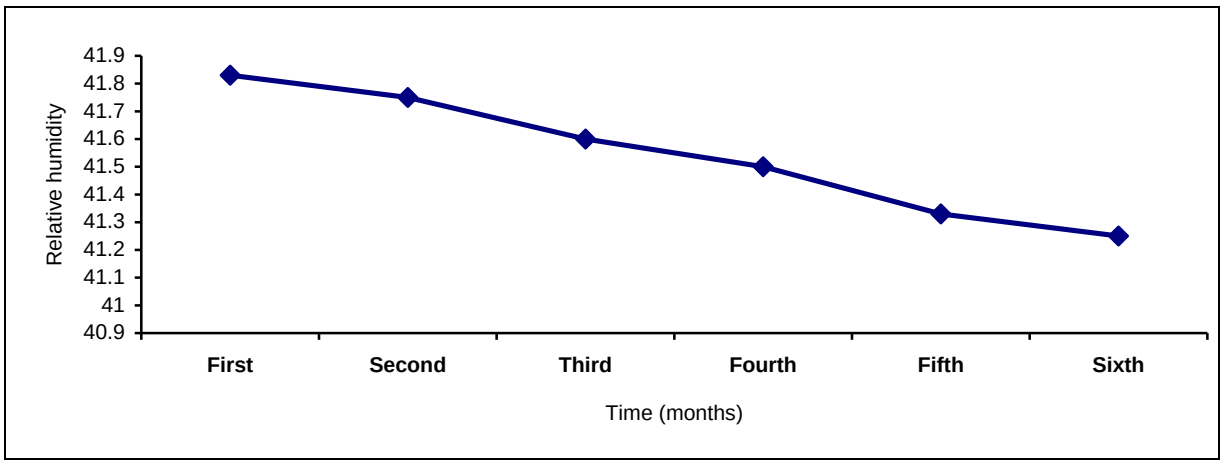

Chart 9- relative humidity changes trend of 'Shahani' rotab flesh in MAP in during of 6 months

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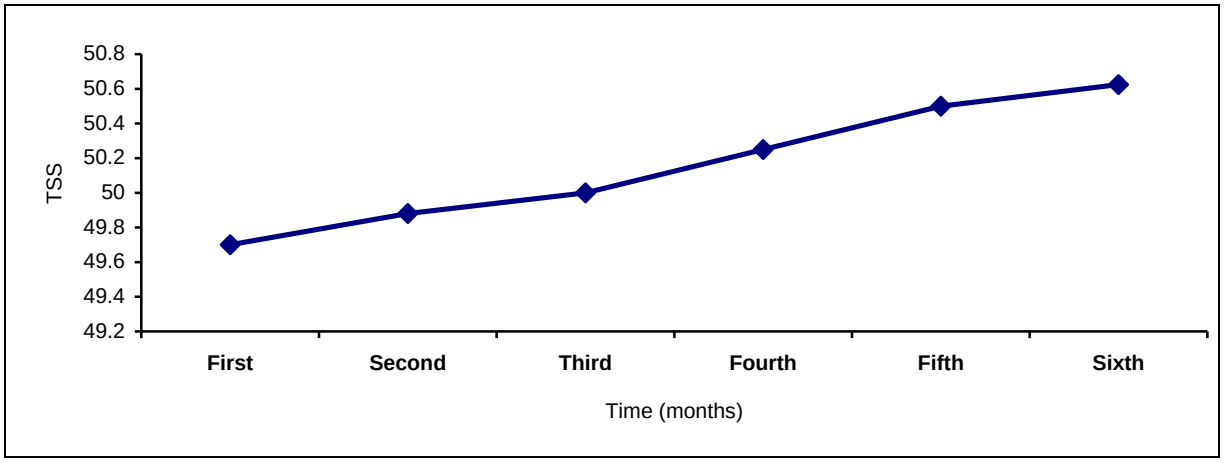

Chart 10- TSS changes trend of 'Shahani' rotab flesh in MAP in during of 6 months

Figure 1- Sugar formation in high concentrations of CO_2

Figure 2- 30% CO_2 + 70% N_2 (left) and 25% CO_2 + 70% N_2 + 5% O_2 (right) treatments

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