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Effect of modified atmosphere packaging on quality changes of fresh parsley, spinach and dill

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*Abstract—***This research was conducted to study effect of modified atmosphere packaging (MAP) on quality of fresh Spinach (*Spinaches oleracea L.*), Parsley (Petroiselinum *hortense*), and Dill (*Anethum graveolens*). Vegetables were packaged in polyethylene pouches. Vegetables were evaluated in three condition included perforated, modified atmosphere active, modified atmosphere passive at different temperature (5ºc, 10ºc, 20ºc, 25ºc).The following properties were determined: vitamin c, chlorophyll, weight loss and total count. Results were indicated that storage of parsley in modified atmosphere active was minimum loss weight and maximum chlorophyll retained. Parsley had the most molds in perforated packages. However, maximum residual vitamin content was seen in MAP parsley.**

Keywords: Dill; Modified atmosphere packaging; Parsley; Spinach

I. INTRODUCTION

Modified atmosphere packaging (MAP) is defined as a gas mixture, which has a composition different from air, and which surrounds the produce for extending shelf life [1, 2]. The mixture is made up primarily of O_2, CO_2, and N_2 [3].Passive MAP is designed for matching of commodity respiratory characteristics with the gas permeability of package system so that a suitable equilibrium MAP can passively evolve through the consumption of O_2 and the evolution of CO_2 in the respiration process [4,5]. On the other hand, an active modified atmosphere can be established by venting air from the package and by back flushing with a selected gas mixture. Products with natural defense structures can be preserved by MAP; the reduction of ripening of product by MA is beneficial for retaining the integrity of epidermal tissue and thus maintaining resistance to spoilage [6]. Higher CO_2 levels can inhibit aerobic microorganism in MAP. Reduction of vegetable respiration rate has been attributed as result of the inhibition of the activity of oxidizes such as poly phenols oxidize, ascorbic acid oxidizes and glycol acid oxidizes [7]. Many researches have been done in field of modified atmosphere packaging. For example, M.L. Amodio, R. Rinaldi, and G. Colelli illustrated the MAP for mixed fresh-cut items including 3 kPa O_2 plus 2 kPa CO_2 for 10 days at 58°C for a ready-to-cook fresh-cut vegetable mixture of parsley, beet, spinach, zucchini, pumpkin, carrot, celery, tomato, savoy cabbage, leek, onion, and rehydrated peas, and 'Barletta' beans [8]. M.I. Gil, F. Ferreres, and F.A. Tomas-Barberan resulted that fresh-cut spinach involved ascorbic acid as a predominant form of vitamin C. However, a reduction in ascorbic acid and an increasing of dehydroascorbic acid was showed during storage. The accumulated dehydroascorbic acid was more prominent in MAP and obtained in a higher vitamin C level for spinach in MAP than air [9].Meanwhile, Y. Mizukami, T. Saito, and T. Shiga indicated that air plus 3–5 kPa CO_2 was helpful for spinach [10].However, R.E. Hardenberg, A.E. Watada, and C.Y. Wang, exhibited that storage in 11% CO_2 + 10% O_2 improved to keep the green color of the leaves during storage [11].Whereas, A .Simon and E. Gonzalez-Fandos, monitored sensory and microbiological quality of fresh peeled white asparagus packaged in two different types (film A: 7% CO_2 and 15% O_2 and film B: 2% CO_2 and 20% O_2) and stored at two different temperatures (5 °C and 10 °C) for up to 14 days. They resulted the shelf life was 6 days at 10 °C, the loss of freshness was the main cause of quality loss, as showed by color darkening and presence of blotches. Also, fresh appearance was kept better at 5 °C than at 10 °C, being microbial spoilage the main limiting factor. The atmosphere produced with film A protected from spoilage and hold the acidity of asparagus better than the atmosphere generated by film B. The shelf life of asparagus packaged in film A and stored at 5 °C was 14 days [12].Even though, F. Charles, C. Guillaume and N. Gontard, studied quality changes of fresh endives undergoing modified atmosphere packaging. Three packaging conditions were examine at 20 °C: a macro perforated oriented polypropylene pouch considered as unmodified atmosphere packaging (UAP) and a low density polyethylene pouch with or without an individual oxygen scavenger sachet to create active or passive modified atmosphere packaging , respectively. By means of a steady modified atmosphere combination of 3 and 4.5 kPa of O_2 and CO_2, respectively, the effect of passive MAP on color changes in endives was like to that of UAP. Advantage of MAP of endives was obtained via O_2 scavenger, i.e. active MAP did not modify O_2 and CO_2 partial pressure during the steady state period but versus to passive MAP involved a 50% decrease of transient time. This falling conducts to a critical lag in greening and browning of endives [13]. Despite the fact, P. A. Gomez and F. Artés, investigated about improved keeping quality of minimally fresh processed celery sticks by modified atmosphere packaging. They showed both MAP treatments developed the sensory quality, without loss of green color, reduced progress of pithiness and retarded the growth of microorganisms. In any treatment neither off-odors nor off-flavors was observed. After 15 days at 4 °C within the oriented polypropylene samples, a steady-state atmosphere of 6 kPa O_2+7 kPa CO_2 was obtained and celery sticks stored under these bags exhibit the best quality [14].On the other hand, when it is not intended to create a modified atmosphere, the main concern is to avoid anoxic conditions and condensation of water vapor inside the package. This is most easily achieved either by incomplete sealing or perforation is to punch holes or perforations, according to, the weight and respiratory requirement of the produce [15]. Much research has been conducted by using perforated packages. For instance, E. R. Brack used perforated polyethylene for watercress, parsley and mint at different conditions. They resulted that respiration rates decreased in the order parsley greater than watercress greater than mint [16]. In another research, untrimmed parsley and celery were packaged in polyethylene films and stored for less than or equal 120 days at 0-2 ºC and 85-93% Relative Humidity. Use of polyethylene bags reduced weight loss of green bean and spinach kept at 20ºc, and reduced chlorophyll loss of green bean at 10ºc and of spinach at 20ºc. Ascorbic acid was maintained through packaging of green beans and spinach kept at 10ºc [17]. The objective of this research is to investigate effect of MAP on quality changes of fresh parsley, spinach and dill.

II. MATERIALS AND METHODS

Spinach, Parsley, and Dill were purchased from a local market, dipped for 1 min in water and disinfected for 5 min in a sodium hypochlorite solution at 10ºc. Vegetable were rinsed with water for 2 min, and separated into subplots for three replicates of packaged and unpackaged samples each temperature-time treatment. For packaged samples, were placed in a 20-cm × 8 cm, 1 mil polyethylene bags with eighteen 6-mm diameter holes. Vegetables were packaged in modified atmosphere by placing them in polyethylene bags, and then replacing the air within the bags by means of a mixture (7 - 10%, O2, 7-10% CO2, and 80-85% N2). Unpacked vegetables were placed in an open tray. The samples were placed at 5ºc, 10ºc, 20ºc and 25 ºc for the time period indicated under results. The following quality attributes were monitored. Weight was monitored. Chlorophyll content was determined by chlorophylemeter as spad unit. Vitamin C was determined by 65507/2 - 1984 ISO method [18]. Total count of microorganisms was determined periodically throughout storage; the culture media for total count and yeast & mold were nutrient agar and sabort dextrose agar respectively. All experiments were done triplicate and then were statistically analyzed.

III. RESULTS AND DISCUSSIONS

Weight loss during storage had significant difference as shown in Fig.1. Spinach lost the most weight among vegetables. However, parsley had at least weight among the vegetables. Because, parsley cuticle was thicker, less free water and stomata number per surface unit. Modified atmosphere packaging was resulted of minimum loss weight (Fig.2). Because the respiration rates of vegetable was restricted and carbohydrate resource was consumed slightly, rate of transpiration was reduced.

Chlorophyll content of parsley at 5ºc was greater than other vegetables. Chlorophyll content of spinach at 25ºc was at least (Fig.3). The difference in chlorophyll content between parsley at 10ºc and dill at 5ºc were not meaning full. Meanwhile, enzyme chlorophyllase activity was maybe little, and then chlorophyll residue would be more. On the other hand, spinach that was lower amount of chlorophyll. When enzyme chlorophyllase activity and other biochemical activities would rise at 25º c, the chlorophyll content was the least amount as compared to the others.

Vitamin c content of vegetables decreased during storage (Fig.4). Parsley lost vitamin C minimally at first day among the treatment, on the other hand, spinach lost vitamin c at the seventh day maximally. Normally, if the vegetable have the least vitamin C content, and maximum rate of catabolism, that would have minimum vitamin content at the end of storage time. As shown that in Fig.5, application of modified atmosphere packaging for samples (passive method) permitted that vitamin content was the most maintenance at first day. Unpacked samples missed maximum vitamin C at the seventh day. Modified atmosphere packaging was maintained the intracellular composition.

Spinach had the most total count in modified atmosphere packaging (active method), meanwhile, perforated dill packs showed the minimum total count (Fig.6). The generation condition would be suitable for micro flora on vegetable surface, that these were anaerobic and facultative anaerobic. Spinach showed the most total count after seventh day; on the other hand, dill exhibited the lowest total count at the first day. Reasons of these results were maybe included: greater free surface, free water and unsuitable condition at transport or postharvest contamination. The effect of temperature- vegetable interaction, was shown on the mold in Fig.7.Spinach had the most mold at 25ºc, whereas, dill was the lowest mold at the same temperature. Above results was improbable, because greater the leaf spinach surface and that mold was mesophilic. Spinach was shown the most molds after seventh day and dill was the least mold by the first day. Because the load of mold per spinach surface was more than dill. Also the population of mold raised along the storage time.

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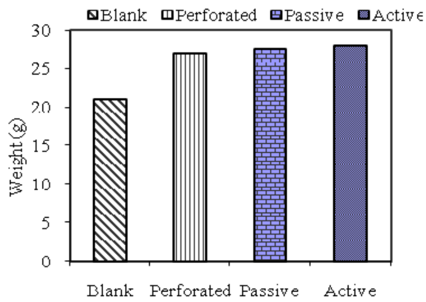

Figure 1.Effect of packaging on weight loss

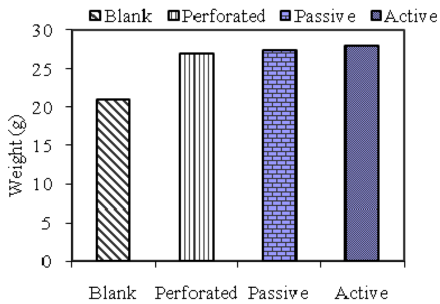

Figure 2.Effect of packaging on weight loss

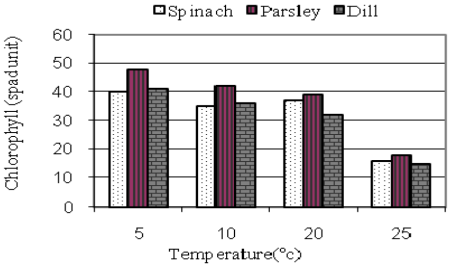

Fig3.Effect of temperature on the content of chlorophyll

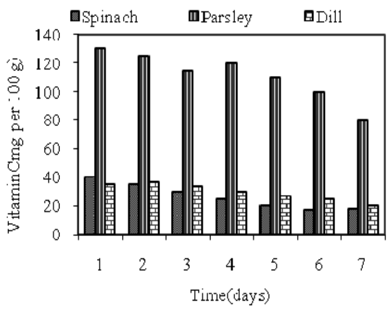

Fig4.Effect of duration time on the content of vitamin c

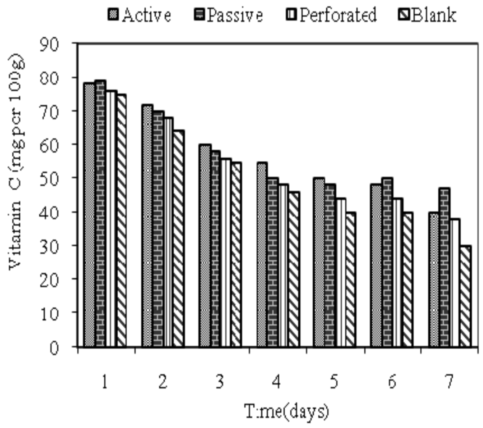

Fig 5.Effect of packaging -time interaction on the vitamin c residual in the vegetables

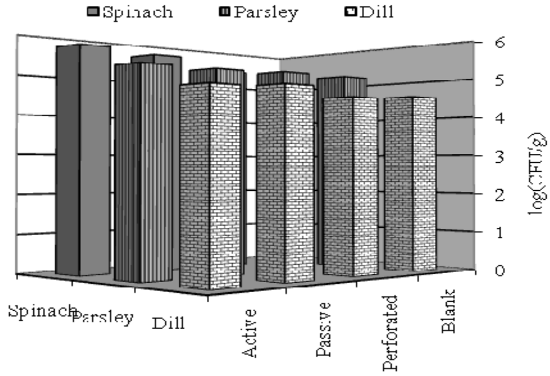

Fig 6.Effect of packaging-vegetable interaction on the total count of microrganism

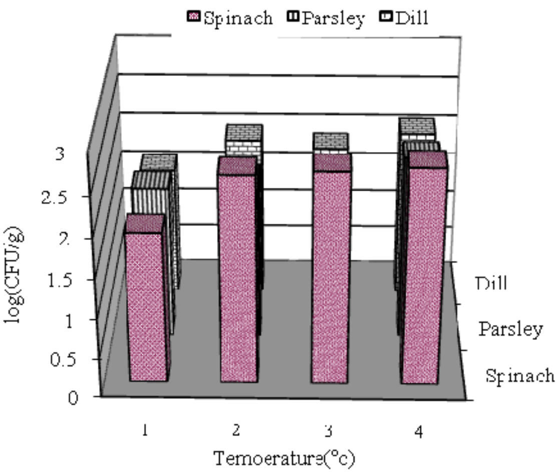

Fig7.Effect of temperature-vegerable interaction on the total count of mold