Analyzing the effect of adding parsnip powder and its extracts on microbial properties of excellent hamburger

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Key words: Antimicrobial properties, Extract parsnip, Hamburger, Parsnip powder.

http://dx.doi.org/10.12692/ijb/6.5.227-241 Article published on March 14, 2015

Abstract

The effect of natural parsnip and its extract on the microbial, physic-chemical characteristics of hamburger were investigated during 9 days. In this study, effect of different concentrations of Ethanol extract (0/25,0/35%) and Aqueous extract of parsnip (0.25,0.35%), and parsnip Powder (0.3,0.4%) and Control sample and storage time (up to 9 days) at Refrigerator temperature was evaluated on a food model system (Hamburger). According to the ANOVA results, most changes in value of pH caused for the sample with 0.25 ethanol extract and slightest change was for the sample with 0.25 aqueous extract. Samples with 0.4% parsnip powder had the lowest number of lactic acid bacteria and samples with 0.25 aqueous extract had highest number of lactic acid bacteria. Control sample had the highest and the sample with 0.25 aqueous extract had a lowest value of total number of bacteria. At the end of storage at refrigerator temperature, the sample with 0.4% parsnip powder had the lowest number of Enterobacteriaceae and the sample with 0.25 aqueous extract had the highest number of Enterobacteriaceae. According to the results of variance analysis, the sample with 0.3% parsnip powder had the maximum amount of Molds and yeasts and the sample with 0.25 aqueous extract had the minimum amount of Molds and yeasts. The results from the present study showed that Psychrotrophic bacteria in hamburger did not grow. Therefore using this 0.4% parsnip powder and 0.35 aqueous extract as natural preservatives in low temperature for meat products is suggested.

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Introduction

Recently, significant effort has been engaged by food processors in order to improve pioneering ready-to-eat food (RTE) products with fresh-like features according to the contemporary urban standard of living, where time for food preparation is restricted (Lui, 2003; Trichopoulou et al., 2003). Parsnip (Pastinaca sativa) is a root native from Europe and Asia that belongs to the Apiaceae family. It is mostly used for culinary purposes or feeding livestock. However, it has been shown in recent times that parsnip roots are a new source of dietary fiber (30%) dry matter (Castro et al., 2012). Parsnip roots have a great content of dietary fibre. Numerous studies informed that there is value of 4.7–4.9% (wet basis) dietary fiber in parsnip (Siddiqui, 1989; Southgate, 2001). Parsnip is a vegetable with a great nutritional values and quality. The storage roots of parsnip comprise significant amounts of sugar, protein and vitamin C, B1, B2 and B6. The value of parsnip is also boosted due to the content of fiber, minerals, containing potassium, phosphorus, calcium, and iron, along with pectin's (Orlowski and Kolota, 1999; Wolski et al. 1999; Kuskowska, 2000; Kolota et al. 2007). Parsnip is valued as herbal raw material. Its herb, roots, and fruits contain various active substances such as essential oils, flavonoids, acetylene, and furanocoumarin compounds (Dyduch and Wolski, 1996). In addition to these well-known micronutrients, vegetables of the Apiaceae plant family including carrots, parsnip, celery, and fennel, contain, in slight quantities, a group of bioactive aliphatic C17-polyacetylenes (Bohlmann, Burkhardt, & Zdero, 1973; Czepa& Hofmann, 2003; Hansen & Boll, 1986; Rai et al., 2011). So far, the fundamental polyacetylenes in vegetables of this family are falcarinol, falcarindiol, falcarindiol-3-acetate. In the plant, these composites have mostly an anti-fungal character (Hansen & Boll, 1986). Ever since the feasible biological relationship of polyacetylenes has come to the light in recent times, less people know about the resistance of them, during the process than for other more recognized phytochemicals, for instance polyphenols and carotenoids. A large part of these studies have tested and examined the results of predictable processing (boiling, vacuum packed processing) on the different levels of polyacetylenes (Hansen, Purup,& Christensen, 2003; Kidmose et al., 2004) containing works in this laboratory (Rawson, Koidis, Patras, Tuohy, & Brunton, 2010a; Rawson, Koidis, Rai, Tuohy, & Brunton, 2010b).

Furthermore, studies assessing the polyacetylene content on different parts of carrot root (anatomical distribution) showed that the “epidermis” (root peel) is rich in particular polyacetylenes (Baranska & Schulz, 2005; Czepa & Hofmann, 2003; Kidmose et al., 2004) however the outcomes seem to be diversity related (Mercier, Ponnampalam, Bérard, & Arul, 1993). Parsnips are well-known as a rich source of at least six furanocoumarins that is: (1), xanthotoxin (2), bergapten (3), isopimpinellin (4), angelicin (5), psoralen and (6), imperatorin (Johnson et al., 1973; Berenbaum et al., 1984; Desjardins et al., 1989; Ekiert and Gomolka, 2000). However Johnson and co-workers (1973) have established that xanthotoxin is a phytoalexin in parsnip roots by indicating its 20-fold analysis in the roots, immunized with several fungi nonpathogenic to parsnip. Parsnip has been grown as a root crop for centuries (possibly millennia) in Europe and other different places, mutually for human use and livestock feed (Grieve 1931). Refined forms produce larger, less acrid, and more succulent roots than natural wild types of parsnip. It is not clear, how the interaction of growing situation and genotype choice affects the nicety or toxicity of crop types, since it become visible as however weedy populations in North America have arisen through the escape and “reversion” of refined crop shapes. Obviously, there are several wild and refined shapes, the former behaving as a weed with very toxic biochemical attributes, and the finally being edible and meaningfully less toxic (Berenbaum etal. 1984). Furanocoumarin levels in wild parsnip roots have not been studied in depth, but are likely to be greater than in the crop plants, as wild plants are under selective pressure from herbivores, whilst crop plants are presumably to be diffuse with larvicide (Gray et al. 1985) and selected for little amount of
Furanocoumarins also have been found to have a possibility to be used as an insect repellents, as they overwhelm feeding and growth in some insect species (Klocke et al. 1989), and have been checked for antibacterial and anti-fungal attributes (Johnson et al. 1973; Fischer et al. 1976; Wolski et al. 2000, 2004). Oils extracted from parsnip seeds have been used to treat “intermittent fever” (Millspaugh 1887; Grieve 1931). Decoctions of the roots have been used as a diuretic (e.g., treatment of kidney stones) and in other medicinal treatments (Grieve 1931). Compared with other Umbelliferae species that have been studied, relatively high levels (7.5 mg) of bioactive polyacetylenes were identified in refined parsnip roots by Zidorn et al. (2005). Other than medicinal benefits (anti-cancer, anti-allergenic, and anti-inflammatory characteristics) of these combinations, some polyacetylenes are recognized to have anti-fungal, antibacterial, and nematocidal effects (Zidorn et al. 2005).

The research objective is, with the addition of the Parsnip, extract or its powder, hamburgers increased durability. In addition, no chemical preservatives, hamburger microbial load does not increase during storage.

**Materials and methods**

**preparation of parsnip powder**

Parsnip roots were previously peeled and cut in cubes (10×10×10 mm). These roots were purchased from Chaloos (Iran). They have been dried in oven at 50 °C for 4 days. In the end samples were milled to the final size of 3–mm. (Moulinex, AW5 Model, France).

**preparation of parsnip extracts**

Fifty grams of parsnip powder were soaked in 1 L of water/ethanol 70% (v/v) and mixed for 24h at room temperature, using a magnetic stirrer (Heidolph MR Hei-standard, Germany). After vacuum filtering (Platinum, JB industries INC, USA), the obtained extract was concentrated under reduced pressure in a water bath set to 45ºC, using a rotary evaporator (Heidolph, Laborata 4000-efficient, Germany). The extract was then stored at 4ºC for further use.

**Sampling**

**Hamburger preparation**

Hamburgers (~85 g) were prepared with fresh beef meat. The meat was ground using meat grinder (Panasonic, MK-G40, Iran) by a 3 mm blade. Seven batches were prepared according to the related formulation: a control batch without parsnip, with 0.3% parsnip powder, with 0.4% parsnip powder, with 0.25% ethanol extract of parsnip, with 0.35% ethanol extract of parsnip, with 0.25% aqueous extract of parsnip and 0.35% aqueous extract of parsnip (Table 2.1). The determination tests were performed on days 1, 3, 6, 9 on seven separate samples in three copies, stored in refrigerator.

Burger1: control sample burger; Burger2: with 0.3% parsnip powder; Burger3: with 0.4% parsnip powder; Burger4: with 0.25% ethanol extract of parsnip; Burger5: with 0.35% ethanol extract of parsnip; Burger6: with 0.25% aqueous extract of parsnip; Burger7: with 0.35% aqueous extract of parsnip.

After mixing the material (pre-mentioned in Table.1) the burgers were shaped into plates with a diameter of 10 cm and a height of ~1 cm. The hamburgers were placed in laminated bags of low permeability and they have been stored to be used and analyzed after 1, 3, 6 and 9 days of storage at 4ºC. From each batch three replicates were made.

**Microbiological analysis**

For microbiological analysis, a 10 g sample of
hamburger was aseptically weighted in a sterile plastic bag, previously removing and discarding the outer plastic. Afterward, samples were homogenized with 90 mL of a sterile solution of 0.1% (w/v) peptone water (Razi serum), containing 0.85% NaCl and 1% Tween 80 as emulsifier, for 2 min at 20–25 °C in a Masticator blender (Pause International, Iran), thus a 1/10 dilution has been prepared. Serial 10-fold dilutions were prepared by mixing 1 mL of the previous dilution with 9 mL of 0.1% (w/v) sterile peptone water. Lactic acid bacteria were counted using duplicate 1 ml volumes of suitable dilutions in covered plates of MRS agar, incubated at 30 °C for 3 days (De Man, Rogosa, & Sharpe, Quelab, Canada). Enterobacteriaceae counts were determined in cover plates of EMB (Eosin Methylene Blue Agar, Quelab, Canada), incubated at 37°C for 24 h. For yeast and mold counts, duplicate 0.2 ml volumes of appropriate dilutions were spread on to the dried surface of pre-poured plates of YGC (Yeast glucose chloramphenicol agar, Quelab, Canada), which were incubated at 25°C for 5 days. Bacteria psychrotropic counts were determined in covered plates of PCA (Plate count agar, Quelab, Canada) incubated at 15°C for 24 h. Lastly, total viable counts were determined using 1 ml of appropriate dilutions on pour-plates of PCA (Plate count agar, Quelab, Canada) incubated at 32°C for 3 days. After incubation, plates with 30–300 colonies were counted. The microbiological data were converted into logarithms of the number of colony forming units (CFU/g).

**pH determination**
The pH of the samples was measured after homogenization with distilled water at a 2:8 ratio, using a digital pH meter (3510 pH Meter, Jenway, England). Means of three measurements were recorded for every different sample.

**Sensory analysis**
The sensory panel evaluation was conducted with 30 sensory judges selected among students in the Department of agriculture, Azad University of Damghan in the third day of the storage. The casing was removed and then, samples were cut in slices of approximately 4 mm thickness. Finally the samples were grilled at 170°C for 10 minutes and served on white plastic dishes. The samples were individually labelled with three-digit random numbers. A quantitative descriptive analysis (QDA) was used for evaluating odor, flavor, texture and overall acceptance. A seven-point hedonic scoring scale (7=excellent; 6=very good; 5= good; 4=moderate; 3=slightly bad; 2=bad; 1=very much bad) was used for evaluation of burgers. At the beginning of the session and in between every different sample, water has been used to wash the plates and remove residual flavors.

**Statistical analysis**
All records were evaluated using the General Linear Model of ANOVA with treatment and time as factors, after normality and homogeneity of variances were confirmed, all statistical evaluates were conducted by using the SPSS statistical package (SPSS 16.00). Differences between means were determined by the least significant difference test, and significance was defined at P<0.05 (with Duncan's Multiple Range Test).

**Results and discussion**

**pH values**
Changes of pH values during the 9-day storage period are presented in Fig. 1. The pH value slightly decreased up until day 3 for all samples, whereas after day 3 there has been a gradual increase for all samples. This is typically related to the increase of Gram-negative bacteria populations (Verma & Sahoo, 2000), such as Enterobacteriaceae and pseudomonads, along with yeasts and molds, which cause protein and amino acid degradation resulting in formation of ammonia which consequently increase pH (Nychas, Drosinos & Board, 1998). At the beginning where the specimens were stored in a refrigerator, pH values in the control sample (4.41) was the lowest and the sample with 0.25 ethanol extract as well as 0.35 ethanol extract (5/06) had the maximum amount of than the average pH values. On the third day, the control sample and the sample with 0.25 aqueous extract (4.39, 4.39) had the lowest and
the sample with 0.35 ethanol extract (4.82) had the maximum amount of than the average pH values. On the sixth day, 0.25 aqueous extract sample had the lowest and the control sample had the highest value than the average pH values. At the end of the 9th day, the sample with the 0.25 ethanol extract (5.34) had the maximum and the sample with 0.35 aqueous extract (5.16) had minimum than the average pH values. Their lower values show that some fermentation had been occurred during the storage of these products, even though no sugars are usually added to our samples with parsnip powder and extract of parsnip. Carbohydrates contained in hamburgers, which are common ingredients of the meat, could be used as substrates for LAB metabolism, which cause the production of organic acids and lower the pH (Papadima et al., 1999).

**Table 1.** Formulation for beef burgers prepared in present study.

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>Burger 1</th>
<th>Burger 2</th>
<th>Burger 3</th>
<th>Burger 4</th>
<th>Burger 5</th>
<th>Burger 6</th>
<th>Burger 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat</td>
<td>61.5</td>
<td>61.5</td>
<td>61.5</td>
<td>61.5</td>
<td>61.5</td>
<td>61.5</td>
<td>61.5</td>
</tr>
<tr>
<td>Onion</td>
<td>24</td>
<td>23.7</td>
<td>23.6</td>
<td>23.75</td>
<td>23.65</td>
<td>23.75</td>
<td>23.65</td>
</tr>
<tr>
<td>Salt</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Red pepper</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Bread crumbs</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Garlic powder</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Turmeric</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Nutmeg</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Parsnip powder</td>
<td>-</td>
<td>0.3</td>
<td>0.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ethanolic extract of parsnip</td>
<td>-</td>
<td>-</td>
<td>0.25</td>
<td>0.35</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Aqueous extract of parsnip</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.25</td>
<td>0.35</td>
<td>-</td>
</tr>
</tbody>
</table>

**Microbiological analysis**

**Lactic acid bacteria**

Results of the microbiological analysis of the samples of hamburger with parsnip powder and parsnip extract through the 9-day storage period are presented in Table 3.2.

**Table 3.** Sensory evaluation of various parameters burgers on the third day of refrigeration.

<table>
<thead>
<tr>
<th></th>
<th>Texture</th>
<th>Flavor</th>
<th>Odor</th>
<th>Overall acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control burger</td>
<td>5.27±</td>
<td>0.52a</td>
<td>5.73±</td>
<td>0.69a</td>
</tr>
<tr>
<td>Burger with 0.3% parsnip powder</td>
<td>5.53±</td>
<td>0.86a</td>
<td>5.73±</td>
<td>0.58a</td>
</tr>
<tr>
<td>Burger with 0.4% parsnip powder</td>
<td>5.57±</td>
<td>0.90a</td>
<td>5.77±</td>
<td>0.57a</td>
</tr>
<tr>
<td>Burger with 0.25% aqueous extract of parsnip</td>
<td>5.17±</td>
<td>0.77c</td>
<td>5.10±</td>
<td>0.66b</td>
</tr>
<tr>
<td>Burger with 0.35% aqueous extract of parsnip</td>
<td>4.67±</td>
<td>0.88c</td>
<td>5.10±</td>
<td>0.74b</td>
</tr>
<tr>
<td>Burger with 0.25% ethanol extract of parsnip</td>
<td>5.20±</td>
<td>0.85c</td>
<td>4.80±</td>
<td>0.68c</td>
</tr>
<tr>
<td>Burger with 0.35% ethanol extract of parsnip</td>
<td>4.87±</td>
<td>0.87c</td>
<td>4.83±</td>
<td>0.82c</td>
</tr>
</tbody>
</table>

All microbial groups increased in the control Hamburger. Increasing trends of different extents were also observed in samples of the remaining treatments for total viable counts, lactic acid bacteria (LAB), yeasts and molds and also Enterobacteriaceae.

According to the results of variance analysis for counts of lactic acid bacteria (LAB), values were meaningfully affected (P < 0.05) by concentration and storage time. Comparison of the data showed that the sample with 0.4% parsnip powder (4.19) and the sample with 0.35 aqueous extract (4.21) have the
lowest amounts of *lactic acid bacteria* (LAB) and the control sample and the sample with 0.25 aqueous extract have the highest counts of *lactic acid bacteria* (LAB). Antimicrobial combinations in parsnip, mostly associated with furanocoumarins Wolski, Dyduck (1998) in the samples with parsnip powder and aqueous extract was more than the other samples and ethanol extract failed to separate them perfectly. Fernandez-Lopez et al. (2005) have informed a small decrease in LAB counts for beef meatballs comprising rosemary extract, after a 12-day storage at 8°C. As far as we know, there have been no reports on the combined usage of rosemary extract along with chitosan in the preservation of meat products.

**Fig. 1.** Effect of natural antimicrobial on pH values of the experimental hamburgers during the 9-days storage period.

**Total viable count**

According to the results of variance analysis for number of *total viable*, values were meaningfully affected (*P* < 0.05) by kind, concentration and storage time. In the final day of storage (after 9 days), sample with 0.4% parsnip powder and both of aqueous extract parsnip presented the lowest microbial load. Johnson et al. (1973) reported the production of xanthotoxin as a phytoalexin of *Pastinaca sativa* roots inoculated with several fungi nonpathogenic to parsnip. This finding was confirmed in this study but the amounts of xanthotoxin reported here were greater than those informed by Johnson and his co-workers. Induction of parsnip roots with CuCl2 in the present study resulted an increase in the amounts of xanthotoxin by 29- fold compared to 20- fold. Although xanthotoxin was found to be the major furanocoumarin component of parsnip root both constitutively (0.051 mg/g fresh weight) and CuCl2 induced (1.47 mg/g fresh weight), the present study shows that xanthotoxin is not the only induced compound in parsnip roots. All other reported constitutive furanocoumarins of parsnip root, with the exception of psoralen and imperatorin, were found to increase similarly in the induced samples. The induced furanocoumarins are bergapten, isopimpinellin, angelicin and sphondin. A large increase in angelicin, psoralen, isopimpinellin and bergapten was also observed in parsnip roots inoculated with *B. sorkiniana*. This is therefore the first confirmation that psoralen, isopimpinellin, bergapten and angelicin are phytoalexins in parsnip roots with a similar effect to xanthotoxin.

**Enterobacteriaceae**

As stated by the results of variance analysis for amounts of *Enterobacteriaceae*, values were considerably affected (*P* < 0.05) by type, concentration and time of storage.

Samples containing parsing powder 0.4% and 0.35 aqueous extract and 0.3% parsnip powder generally had lower microbial counts compared to the remaining samples. This indicates more phenolic
compounds in powder that causes more antimicrobial activity. Darmadj and Izumimoto (1994) have reported meaningfully lower counts of *pseudomonads*, *S. aureus*, *coliforms*, *Gram-negative bacteria*, *total viable flora* and *micrococci* in fresh minced beef comprising 1% chitosan and stored for 10 days at 4°C. Noori et al. (2012) have examined the antimicrobial effect of different concentrations of *Zataria multiflora* Boiss essential oil at supplementation levels of (0, 0.005, 0.015, 0.03%) on *E.coli O157:H7* in minced beef. All of the pre-mentioned concentrations indicate adequate organoleptic characteristics in minced beef. At 0.03% there has been found a strong antibacterial activity against *E.coli O157:H7* in minced beef and they determined the correlation coefficient of diverse concentrations of *Zataria multiflora* Boiss essential oil with logarithm of the numbers of *E.coli O157:H7* was \(-0.701, -0.599\) at 4 and 10°C respectively. This shows that the influence of diverse concentrations of essential oil on *E.coli O157:H7* growth rate was statistically great (p<0.01).

**Fig. 2.** Effect of storage time on Log LAB for burger treatments.

**Yeast and mold**
According to the results of variance analysis on the number of yeast and mold, values were significantly affected (P < 0.05) by type of additive used in the sample. Minimum number of mold was found in samples with 0.25 aqueous extract and sample with 0.35 asqueous extract. Maximum number of yeast and molds were found in the sample with 0.3% parsnip powder. The average number of yeast and mold in the control sample was 2.50.

According to results of variance analysis on the number of yeast and mold, values were not significantly affected (P > 0.05) by concentration. Hence, with increasing concentrations of each additive, no significant reduction was found in the number of yeast and mold.

The antimicrobial action of parsnip might be due to its interaction with membranes and cell wall components, which increases the permeability of the membranes and leakage of cell material from tissue, or as well, it might be due to its water-binging capacity and inhibition of various enzymes (Helander, Nurmi-aho -Lassila, Ahvenainen, Rhoades, & Roller, 2001; Young, Kohle, & Kauss, 1982). Parsnip has also the ability to absorb nutrients of bacteria and thus inhibits their growth (Knorr, 1991). All these properties, and especially its interaction with cell walls enhance the ability of parsnip to inhibit growth of *Gram-negative bacteria*, in contrast with many antimicrobial substances (e.g. bacteriocins), that are commonly active against *Gram-positive bacteria* (Helander et al., 2001; Tsai & Su, 1999).

**Psychrotrophic bacteria**
The result of this study have showed that *Psychrotrophic bacteria* cannot grow. Roller et al.
(2002) added 0.6% chitosan combined with sulphites to fresh pork sausages and have observed a 1–2log10 cfu/g decrease in LAB, total viable flora and yeasts and molds amounts compared to the control sample, after 24 days of refrigerated storage. As far as the antimicrobial effects of rosemary are concerned, a noteworthy reduction of psychrotrophic bacteria and a shelf life extension of 10 days compared to the control samples were reported by Djenane et al. (2002) in beef steaks, which have been stored at 1°C.

![Fig. 3. Effect of storage time on Log Total for burger treatments.](image)

**Sensory evaluation**

According to variance analysis and table 3, the sample with parsnip powder (5.77) and the control sample (5.73) have the highest rate of Flavor and Taste. The highest rating for the texture characteristic belongs to the sample with parsnip powder in both of concentration. According to the sensory judges, the lowest score for texture belongs to the samples containing 0.35% ethanol and aqueous extract.

![Fig. 4. Effect of storage time on Log Enterobacteriaceae for burger treatments.](image)

According to variance analysis, the control sample (5/90) has the highest rate of odor and the lowest scores belongs to the samples with ethanol extract in both of concentration.

According to variance analysis, no difference (p > 0.05) has been detected in the Overall acceptance between the different formulations of burgers. But statistically, there was a significant but meaningless difference, in which the control sample (5/23) has the highest rating for overall acceptance and the lowest score was belongs to the sample containing 0.25% aqueous extract.
Fig. 5. Effect of storage time on Log yeast and mold for burger treatments.

Conclusion
Results of the present study demonstrate the effectiveness of parsnip powder, added individually or with ethanol extract or aqueous extract on microbial growth inhibition, and shelf life extension of beef burgers, stored in refrigerator (4°C) for 9 days.

Sample with 0.4% parsnip powder and sample with 0.35% aqueous extract which showed the best results, could have a valuable potential for commercial use in order to improve preservation of these products without the use of other additives. Further research could investigate the combined application of powder and extract of parsnip in hamburger products as well as the use of different quantities than those used in this study for optimization of their antimicrobial effects.

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