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Full Length Research Paper

Effect of frying oils on quality characteristics of frozen chicken patties incorporated with honey

Badriah Alabdulkarim, Zubaida Abdel Nabi Bakeet and Shaista Arzoo*

Department of Food and Nutrition Sciences, King Saud University. P.O. Box: 22452, Riyadh – 11495, Kingdom of Saudi Arabia.

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In this study, effect of honey (0, 5 and 10%) and frying oils (palm olein and corn) on physicochemical, proximate characteristics (Thiobarbituric acid reactive substances (TBARS), pH, fat, moisture) and sensory properties of frozen chicken patties have been evaluated. TBARS, pH and fat content significantly ($p \leq 0.05$) increased during storage period of 60 days. Whereas significant ($p \leq 0.05$) decrease in moisture content of frozen chicken patties were recorded during storage. Honey treatment significantly ($p \leq 0.05$) reduced the increase in TBARS, pH and fat content of frozen chicken patties. The treatment of chicken patties with 10% honey treatment had minimum moisture, TBARS, pH and fat content throughout storage. TBARS value and fat content of chicken patties fried in palm olein oil was less than corn oil. Positive correlation ($p \leq 0.05$) of TBARS value with fat content and pH was observed, while negative correlation ($p \leq 0.05$) of TBARS value with flavor and overall acceptability was found in this study. All sensory attributes significantly ($p \leq 0.05$) declined as storage time increased. The overall acceptability (sensory attributes) of frozen chicken patties treated with 5% honey and fried in palm olein oil was highest.

Key words: Chicken, honey, palm olein, corn, TBARS, sensory, storage period.

INTRODUCTION

Chicken meat is categorized as white meat and from nutritional perspective it is considered superior and healthier than red meat. It has good fat profile, having low saturated fat, and high monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) content. It is also a good source of protein, minerals, vitamins (Ashgar et al., 1990; Sotelo and Perez, 2003). With changing life style and time crisis, demand for processed and convenience foods is increasing at an unprecedented rate. Boiling, frying, steaming, barbecuing are the routine methods for the preparation of chicken. Frying has significant advantages over other cooking methods, both in term of nutritional aspects and sensory characteristics. During deep frying, the time required is generally short and the temperature inside the products remains below 100°C, but there is less loss of water soluble vitamins (Bognar, 1998; Saguy and Dana, 2003). However, nutrients such as carbohydrates, minerals and proteins are retained (Bognar, 1998).

The type and quality of oil used for frying plays an important role in physicochemical and organoleptic changes (Jacobson, 1991). It influences the quality and shelf life of fried products. The oxidative deterioration of lipid is one of the major deleterious reactions resulting in rancidity of fried food products (Kahkonen et al., 1999). Vegetable oils consists of ester mixtures, derived from glycerol, with chains of fatty acid containing about 14 to 20 carbon atoms with different degrees of unsaturation (Aluyor and Jesu, 2008). Corn oil which is a good source of essential fatty acids, it consists of 54.67% PUFA (97.87% ω-6 linoleic acid, 2.12% ω-3 linolenic acid), 27.56% MUFA (oleic acid) and 12.948% saturated fatty acid (palmitic acid 81.703%, stearic acid 14.27% and arachidic acid 3.32%) (USDA, 2007). Palm olein, a liquid fraction obtained from the refining of palm oil contains approximately an equal amount of saturated and unsaturated fatty acids. Palm olein consists of 45% palmitic acid, 5% stearic acid as saturated fatty acids and 42.7 to 43.9% oleic acid which is a monounsaturated fatty

*Corresponding author. E-mail: sarzoo@ksu.edu.sa. Tel: +96614785968 ext: 1484 or +966566091562.

acid. It is also rich in β-carotene and vitamin E such as toco-pherols and tocotrienols (Narang et al., 2004). Chicken patties are battered products which come under the category of “heat and serve” type of food. Heat and serve type of food are more susceptible to lipid oxidation, which in turn increases lipid hydroperoxides as reheating liberates heme iron from myoglobin, but it decreases shelf life of the product (Kerler and Grosch, 1996).

Consumers are becoming more health conscious and are moving towards natural products, as they are considered better, safer and healthier than synthetic products that have negative effects on human health (Boyd et al., 1993). Natural antioxidants added at concentration that do not affect sensory properties of meat can be alternative to the synthetic antioxidants (Antony et al., 2000). Honey is gaining popularity because of its nutritive value and functional characteristics, and it is widely used in meat products because it provides a synergistic antioxidant effect (Al-mamary et al., 2002; Nagai et al., 2006; Brudzynski and Miotto, 2011). The antioxidant capacity of honey and propolis is mainly due to the presence of phenolic compounds and flavonoids (Aljadi and Kamaruddin, 2004). Honey is also effective in reducing the risk of developing many diseases (Khalil and Sulaiman, 2010; Kumar et al., 2010).

In this study, physicochemical and sensory qualities of frozen chicken patties incorporated with honey and fried in palm olein and corn oil has been described.

MATERIALS AND METHODS

Raw materials

Frozen grounded chicken meat, oils (palm olein and corn), Acacia honey (Sudan), spices, fine flour and polybags were purchased from local market (Saudi Arabia).

Chemicals

Buffer solution of pH 4.0 and 7.0 were obtained from BDH Laboratory, England. Chloroform (Sigma, USA), acetic acid (Sigma, USA), thiobarbituric acid (Sigma, USA) and tricarboxylic acid (Sigma, USA) were of analytical grade.

Procedure for preparation of chicken patties

Frozen minced chicken meat was thawed at 4°C for 4 to 5 h before use. Spices mixture was prepared (Black pepper powder - 2 g, White pepper powder - 2 g, Turmeric powder - 2 g, MSG - 2 g, Cumin powder - 2 g, Coriander powder - 2 g and salt – to taste) for each treatment. Three blends were formulated as follows:

Minced chicken 2 kg + 0 g honey + spice mixture
Minced chicken 1.9 kg + 100 g honey + spice mixture
Minced chicken 1.8 kg + 200 g honey + spice mixture

Each portion was mixed manually in a bowl to obtain a homogenous mixture. The mixtures were formed into patties using a petri-dish (75 × 15 mm) to give uniform shape. The patties were then - frozen at temperature -2 to 0°C for 2 h to facilitate shaping of chicken patties. Batter was prepared by using 200 g refined flour, 2 to 3 g table salt and 100 ml water (Ali and Rasool, 2007). Batter was applied uniformly on chicken patties. Each portion of 0, 5 and 10% honey treated patties were subdivided into 2 portions for frying in palm olein and corn oil at 180°C for 3 to 4 min or until a brown colour was maintained. Deep fryer (Moulinex, China) was used so that temperature and time duration can be maintained.

Packaging and storage of prepared products

After frying, chicken patties were cooled up to 10 to 12°C and then packed in polythene bags and sealed with sealing machine (Double Leopards, Taiwan). A total of six lots of products (1 control and two honey treated chicken patties × 2 oil treatments) were developed and each lot was divided into four sub lots for analysis on 0th, 20th, 40th and 60th day. After analyzing the products on day 0, the remaining patties were stored at -18°C for subsequent analysis.

Chemical analysis

Samples were ground into fine pieces before being analyzed. The prepared samples were analyzed for moisture (Vaccum oven, Haraeus, VT 5042 EK, Germany), and fat (Soxtest, SX-6 MP, Raypa, Spain) content according to their respective method given in AOAC (1995). Five gram of sample was thoroughly homogenized with 50 ml distilled water in a blender jar (Philips, Brazil) at high speed for 2 min and homogenate was used to determine the pH by following the method of Antony et al. (2006). The pH meter (Mettler Toledo, MP 220, Switzerland) was calibrated with standard buffers (4, 7) before pH was measured. TBARS were determined as reported earlier by Strange et al. (1977)

Sensory evaluation

The chicken patties were evaluated for sensory parameters such as color, flavor, juiciness and overall acceptability. Semi-trained panel of 5 judges of different eating habits and different ages were asked to rate the acceptability of the product on 9 point hedonic scale. This test was used to measure the acceptability of consumers for chicken patties. Prior to evaluation, samples were warmed to 40°C in microwave oven (Panasonic, Japan) for 50 s. Water was given to the panellist to clear the palate before and between tasting.

Statistical analysis

The data obtained was subjected to statistical analysis by conducting analysis of variance (ANOVA), using xlstat software package (version 2011.4.02). The significant difference of means were compared using Duncan’s multiple range test and each data in table was presented as average of three replicates ± SD and p value was considered significant at 95%. Correlation coefficients were used to determine relationship among quality parameters.

RESULTS AND DISCUSSION

Physicochemical properties and proximate analysis of frozen chicken patties incorporated with honey and fried in palm olein and corn oil

Moisture content

The effect of honey and oil treatments on moisture con-

Table 1. Moisture and fat content of frozen chicken patties incorporated with honey (0, 5 and 10 %) and fried in palm olein and corn oil.

Moisture content (%)		Storage period (day)			
Honey (%)	**oil**	**0**	**20**	**40**	**60**
0	palm	$59.07^{c} \pm 2.16$	$57.40^{d} \pm 0.20$	$56.66^{e} \pm 1.15$	$50.87^{j} \pm 1.92$
	corn	$64.00^{a} \pm 0.00$	$60.06^{b} \pm 1.70$	$59.26^{c} \pm 2.83$	$56.07^{f} \pm 0.92$
5	palm	$58.26^{c} \pm 2.72$	$55.20^{g} \pm 3.22$	$54.73^{g} \pm 4.44$	$50.00^{k} \pm 2.00$
	corn	$60.86^{b} \pm 1.13$	$59.33^{c} \pm 1.15$	$58.33^{c} \pm 1.15$	$53.13^{h} \pm 3.30$
10	palm	$53.07^{h} \pm 0.81$	$52.00^{i} \pm 0.00$	$51.60^{i} \pm 3.64$	$45.00^{m} \pm 4.70$
	corn	$58.33^{c} \pm 3.82$	$51.80^{j} \pm 3.14$	$50.20^{k} \pm 1.25$	$49.50^{l} \pm 3.89$
Fat content (%)					
0	palm	$11.50^{e} \pm 0.44$	$11.86^{c} \pm 0.11$	$11.95^{c} \pm 0.10$	$12.27^{a} \pm 0.15$
	corn	$11.93^{c} \pm 0.06$	$12.26^{a} \pm 0.00$	$12.60^{a} \pm 0.10$	$12.90^{a} \pm 0.20$
5	palm	$11.00^{e} \pm 0.00$	$11.20^{e} \pm 0.20$	$11.30^{e} \pm 0.20$	$11.67^{e} \pm 2.89$
	corn	$11.43^{e} \pm 0.06$	$11.50^{e} \pm 0.00$	$11.90^{c} \pm 0.10$	$12.17^{a} \pm 0.12$
10	palm	$10.16^{b} \pm 2.25$	$10.40^{d} \pm 0.53$	$10.40^{d} \pm 0.60$	$10.60^{e} \pm 0.69$
	corn	$10.60^{e} \pm 0.90$	$10.70^{e} \pm 0.10$	$10.90^{e} \pm 0.52$	$11.20^{e} \pm 1.25$

Data are mean ± S.D of three replicates. Mean values having different superscripts letters in columns and rows are significantly different ($p \leq 0.05$).

tent (%) of frozen chicken patties is presented in Table 1. Moisture is a predominant constituent in many food products. The moisture content is an index of water activity (Olutiola et al., 1991). Moisture content of frozen chicken patties incorporated with different concentration of honey and fried in two different oils (palm olein and corn) were found to decrease gradually, this decrease was significant ($p \leq 0.05$).

Arief et al. (1989) stated that loss of moisture during storage was due to evaporation of moisture from meat during storage. A significant ($p \leq 0.05$) effect of honey and oils was found on the moisture content of product. As the level of honey added to chicken patties fried in palm olein and corn oil increased, its moisture content decreased. This linear relationship may be due to low percentage of water presented in honey. The highest moisture content was reported for the frozen chicken patties without honey and this result was consistent with previous reports where same trend was found in meat products treated with honey (Tuley, 1989; Antony et al., 2006). Honey incorporated samples were easily formed and shaped compared to control. Wan Rosli et al. (2011) mentioned that the appropriate levels of moisture content in any processed meat based products should not exceed 62% to avoid difficulty in proper shaping during forming process. Belewu and Morakingo (2009) stated that high osmotic pressure and low water activity of honey lead to the reduction of moisture content.

Fat content

The effect of honey and oil treatments on fat content (%) of frozen chicken patties is presented in Table 1. With the progress of storage time, significant ($p \leq 0.05$) increase in fat content was observed in frozen chicken patties. Also significant ($p \leq 0.05$) effect of oils and honey treatments were observed on the fat content of frozen chicken patties. Frozen chicken patties incorporated with 10% honey and fried in palm olein oil recorded had only 10.16 % fat on the day of preparation. The fat content of frozen chicken patties incorporated with 5% honey was also significantly lower ($p \leq 0.05$) than control. The low fat detected in frozen chicken patties formulated with 5 and 10% honey as compared to chicken patties without honey, this may be due to lack of fat in honey. Moreover, percentage increase in fat content during storage was maximum in chicken patties without honey and fried in corn oil (8.13%) and least in 10% honey treated samples fried in palm olein oil (4.33%). Increasing trend in fat content during storage has also been reported earlier (Rao and Reddy, 2000; Bhatt et al., 2011).

pH

The effect of honey and oils on pH of frozen chicken patties is presented in Table 2. The pH value of frozen chicken patties decreased during the first 20 days of storage and then increased. Storage period had significant ($p \leq 0.05$) effect on the pH of frozen chicken patties. The reduction in pH of frozen chicken patties may be due to growth of psychrophilic gram positive bacteria especially lactic acid bacteria (Shelef, 1975) and increase in pH may be due to aging (Jin et al., 2007). Amino acid breakdown through deamination might also be responsible for rise in pH during storage (Antony et al., 2006; Ozer and Saricoban, 2010).

Table 2. pH and TBARS values of frozen chicken patties incorporated with honey (0, 5 and 10 %) and fried in palm olein and corn oil.

pH value		Storage period (day)			
Honey (%)	**oil**	**0**	**20**	**40**	**60**
0	palm	$6.24^{e} \pm 0.006$	$6.08^{h} \pm 0.040$	$6.29^{e} \pm 0.075$	$6.52^{a} \pm 0.084$
	corn	$6.25^{e} \pm 0.006$	$6.13^{g} \pm 0.010$	$6.26^{e} \pm 0.006$	$6.54^{a} \pm 0.047$
5	palm	$6.23^{e} \pm 0.006$	$6.06^{h} \pm 0.021$	$6.23^{e} \pm 0.006$	$6.49^{c} \pm 0.090$
	corn	$6.19^{f} \pm 0.011$	$6.09^{h} \pm 0.163$	$6.14^{g} \pm 0.006$	$6.41^{b} \pm 0.031$
10	palm	$6.05^{h} \pm 0.025$	$5.93^{i} \pm 0.020$	$6.07^{h} \pm 0.006$	$6.24^{e} \pm 0.006$
	corn	$6.05^{f} \pm 0.025$	$5.84^{i} \pm 0.032$	$6.05^{h} \pm 0.010$	$6.31^{d} \pm 0.105$
TBARS value					
0	palm	$0.10^{p} \pm 0.000$	$0.20^{j} \pm 0.115$	$0.29^{f} \pm 0.004$	$0.65^{b} \pm 0.003$
	corn	$0.18^{k} \pm 0.019$	$0.45^{c} \pm 0.050$	$0.30^{e} \pm 0.013$	$0.80^{a} \pm 0.050$
5	palm	$0.12^{n} \pm 0.019$	$0.14^{m} \pm 0.021$	$0.20^{j} \pm 0.008$	$0.38^{d} \pm 0.027$
	corn	$0.11^{n} \pm 0.006$	$0.25^{h} \pm 0.005$	$0.18^{k} \pm 0.011$	$0.43^{c} \pm 0.017$
10	palm	$0.10^{o} \pm 0.006$	$0.14^{l} \pm 0.022$	$0.13^{n} \pm 0.003$	$0.26^{g} \pm 0.011$
	corn	$0.10^{n} \pm 0.111$	$0.23^{j} \pm 0.017$	$0.10^{p} \pm 0.003$	$0.29^{f} \pm 0.014$

Data are mean ± S.D of three replicates. Mean values having different superscripts letters in columns and rows are significantly different ($p \leq 0.05$).

Significant ($p \leq 0.05$) difference in pH was found between means of honey treatment. Mean score of frozen chicken patties incorporated with 10% honey showed lowest value (6.070) and those incorporated with 0% honey showed highest value (6.288) and mean value of samples fried in palm olein oil was more (6.203) than samples fried in corn oil (6.188). Treated groups (5 and 10% honey) had significantly ($p \leq 0.05$) lower pH than chicken patties not treated with honey perhaps by reducing psychotropic bacterial load. With increase in concentration of honey, concentration of carbohydrates also increases which would delay the onset of amino acid utilization (Jay, 1996) which may be the reason for less increase in pH for 5 and 10% honey treated frozen chicken patties. This result is consistent with the report of Antony et al. (2006), who also found reduction in the pH of turkey slices as the level of honey increased.

Thiobarbituric acid reactive substances (TBARS)

The effect of honey and oils on TBARS of frozen chicken patties is presented in Table 2. The TBARS value of honey treated and untreated frozen chicken patties fried in palm olein and corn oil significantly ($p \leq 0.05$) increased with storage time. This increase in TBARS value during storage has also been previously reported (Nath, 1995; Brewer et al., 1998; Biswas et al., 2011). The TBARS value of all groups was lowest at day zero compared to other storage period. In some previous reports, it has been found that freeze storage increased malonaldehyde concentration in chicken patties (Lai et al., 1991; Ozer and Saricoban, 2010).

Lipid oxidation products (TBARS) were significantly ($p \leq 0.05$) reduced in honey treated groups and fried in palm olein and corn oil as compared to sample not treated with honey. Also, a significant ($p \leq 0.05$) difference was observed in TBARS value when two oils were used for frying. At the end of the storage period the maximum value was found in chicken patties not treated with honey and fried in corn oil, and least in the chicken patties treated with 10% honey and fried in palm olein oil. This may be due to presence of unsaturated fats in the corn oil which could be oxidized to form TBARS (Grau, 2001). Similar effect of honey on TBARS value over a storage period was also observed in other studies (Johnston et al., 2005; Antony et al., 2006).

Sensory analysis of frozen chicken patties incorporated with honey and fried in palm olein and corn oil

The sensory evaluation is one of the most important criterions in food industry to find the acceptability of the product. The patties were analyzed for color, flavor, juiciness and overall acceptability at 0th, 20th, 40th and 60th day. A gradual decline was observed in sensory attributes during storage in all treated groups. The reduction in sensory score may be due to loss of flavor, dehydration and microbial activity. Nath et al. (1995) reported decrease in sensory scores of chicken patties throughout the storage period of 60 days.

Color

Color is a quality factor that greatly influences appea-

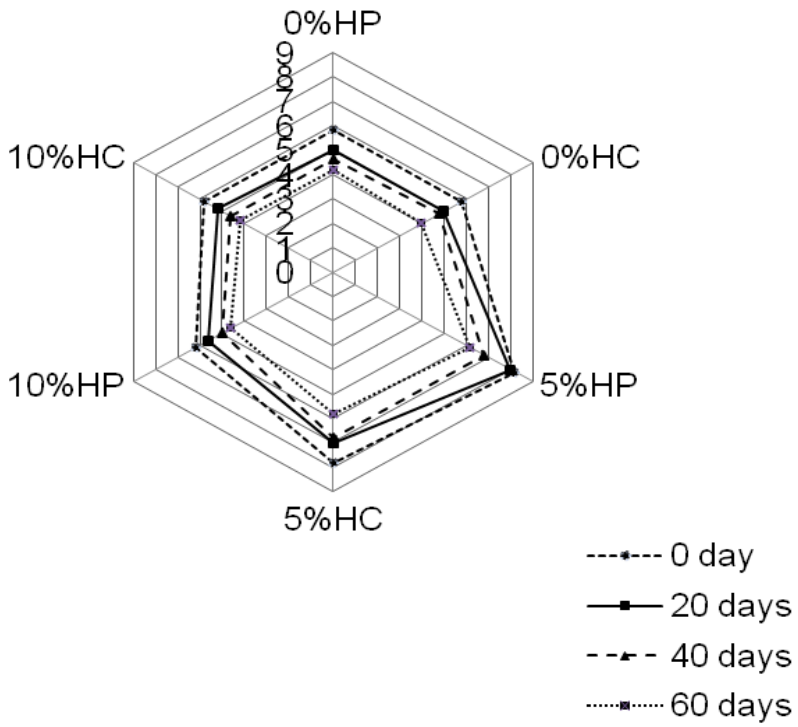

Figure 1. Effect on color of frozen chicken patties incorporated with honey (0, 5 and 10%) and fried in palm olein and corn oil. 0% HP-chicken patties treated with 0% honey and fried in palm olein oil, 0% HC- chicken patties treated with 0% honey and fried in corn oil, 5% HP- chicken patties treated with 5% honey and fried in palm olein oil, 5% HC- chicken patties treated with 5% honey and fried in corn oil, 10% HP- chicken patties treated with 10% honey and fried in palm olein oil, 10% HC- chicken patties treated with 10% honey and fried in corn oil.

rance of the meat and its products and in turn influences its acceptability to consumers (Glitch, 2000). Significant ($p \leq 0.05$) decrease in color of frozen chicken patties was found throughout storage period of 60 days (Figure 1). Various factors such as concentration, chemical state of meat pigment, physical properties of the meat and presence of non meat ingredients affects the color of the meat products (Sayago Ayerdi et al., 2009).

Flavor

Flavor is the result of interaction of taste, odor, and texture feelings after consumption of food which in turn is due to compounds responsible for taste, odor and aroma. Flavor of frozen chicken patties were significantly ($p \leq 0.05$) decreased during storage period of 60 days (Figure 2). The difference was statistically significant ($p \leq 0.05$) among three groups. Mean score of frozen chicken patties incorporated with 10% honey level showed highest value (6.750) and those incorporated with 0% honey level showed least value (5.575) and mean value of palm olein oil treated samples were slightly more (6.2) than corn oil (6.1) treated sample. Microbial growth and oxidative rancidity might be the reason for decrease in flavor during storage (Miller et al., 1980; Devatkal et al., 2003).

Juiciness

The juiciness of chicken patties was found to be decreased significantly ($p \leq 0.05$) throughout the storage period of 60 days (Figure 3). The difference in juiciness was found to be statistically significant ($p \leq 0.05$) in all groups. Mean score for juiciness of frozen chicken patties incorporated with 0% honey level showed highest value (6.075) and those incorporated with 10% honey level showed least value (4.900) and mean value of corn oil treated samples were significantly ($p \leq 0.05$) more (5.642) than palm olein oil (5.383) treated sample. Decrease in juiciness may be due to loss of moisture from the product due to the permeability of low density polyethylene to water vapor (Eyas, 2001). The lower fat content in patties with added honey could also contribute to the lower scores of juiciness. (Aleson –Carbonella et al., 2005). The overall acceptability values were found to be significantly ($p \leq 0.05$) lowered during frozen storage

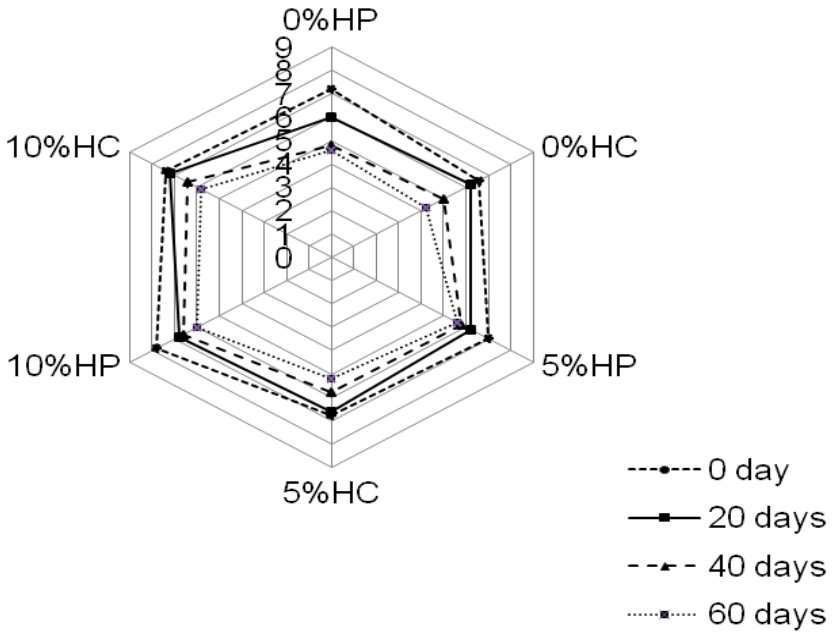

Figure 2. Effect on flavour of frozen chicken patties incorporated with honey (0%, 5% and 10%) and fried in palm olein and corn oil.0%HP-chicken patties treated with 0% honey and fried in palm olein oil, 0% HC- chicken patties treated with 0% honey and fried in corn oil, 5% HP- chicken patties treated with 5% honey and fried in palm olein oil, 5% HC- chicken patties treated with 5% honey and fried in corn oil, 10% HP- chicken patties treated with 10% honey and fried in palm olein oil, 10% HC- chicken patties treated with 10% honey and fried in corn oil.

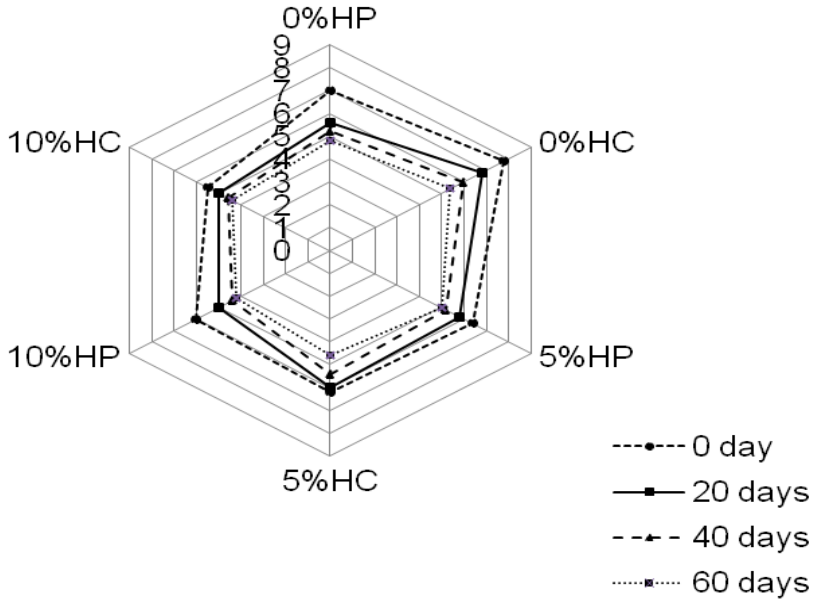

Figure 3. Effect on juiciness of frozen chicken patties incorporated with honey (0, 5 and 10%) and fried in palm olein and corn oil. 0% HP-chicken patties treated with 0% honey and fried in palm olein oil, 0%HC- chicken patties treated with 0% honey and fried in corn oil, 5% HP- chicken patties treated with 5% honey and fried in palm olein oil, 5% HC- chicken patties treated with 5% honey and fried in corn oil, 10% HP- chicken patties treated with 10% honey and fried in palm olein oil, 10% HC- chicken patties treated with 10% honey and fried in corn oil.

Table 3. Correlation of physicochemical, proximate and sensory attributes of frozen chicken patties incorporated with honey (0, 5 and 10%) and fried in palm olein and corn oil.

Parameter	Moisture	TBARS	pH	Fat	Colour	Flavour	Juiciness	Overall acceptability
Moisture	1.00	-0.142	-0.064	0.322	0.390	0.143	0.862**	0.474*
TBARS	-0.142	1.00	0.715**	0.712**	-0.514*	-0.792**	-0.191	-0.723**
pH	-0.064	0.715**	1.00	0.670**	-0.236	-0.740**	-0.069	-0.551**
Fat	0.322	0.712**	0.670**	1.00	-0.235	-0.767**	0.268	-0.478*
Colour	0.390	-0.514*	-0.236	-0.235	1.00	0.459*	0.398	0.783**
Flavour	0.143	-0.792**	-0.740**	-0.767**	0.459*	1.00	.331	0.865**
Juiciness	0.862**	-0.191	-0.069	0.268	0.398	0.331	1.00	0.630**
Overall Acceptability	0.474*	-0.723**	-0.551**	-.478*	0.783**	0.865**	0.630**	1.00

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

period. This is in agreement with earlier findings of Egbert et al. (1991).

Correlation of physicochemical, proximate and sensory attributes of frozen chicken patties incorporated with honey and fried in palm olein and corn oil

The statistical analysis of results (Table 3) revealed a significant positive ($p \leq 0.01$) correlation of moisture with juiciness. Juiciness of meat product was due to the moisture released by the product during chewing and moisture from saliva (Winger and Hagyard, 1994). TBARS value of frozen chicken patties treated with honey and fried in palm olein and corn oil was positively ($p \leq 0.01$) correlated with fat and pH and negatively ($p \leq 0.01$) correlated with flavor and overall acceptability. TBARS values were also found to be negatively correlated with color ($p \leq 0.05$). Positive and highly significant ($p \leq 0.01$) correlation between fat content and TBARS value indicates that increasing fat content promoted increased lipid oxidation and resulted in higher TBARS value. The quantitative production of malonaldehyde during oxidation of fat in food is responsible for TBARS value correlation with off flavor and rancidity of meat and meat products (Klose et al., 1959). Various other workers also reported a similar negative correlation between TBARS values and sensory flavor sore (Greens and Cumuze, 1982; Biswas et al., 2011). Jin et al. (2007) reported that lipid oxidation results in formation of an array of products which directly or indirectly decreases the sensory quality of meat products. There are various factors responsible for oxidation, such as temperature, light, availability of oxygen, presence of moisture and metals. Overall acceptability of frozen chicken patties treated with honey and fried in palm olein and corn oil stored at frozen temperature was positively ($p \leq 0.01$) correlated with color, flavor and juiciness. This result is in congruent with the works of Biswas et al. (2011) who also reported positive correlation of overall acceptability with color, flavor and juiciness. Also the work of Arafa and Chen (1976) on chicken patties confirms these present findings.

Conclusion

The result of this study points out that moisture content of samples decreased during storage, while pH, fat and TBARs value were increased during storage. Sensory attributes such as color, flavor, juiciness and overall acceptability also decreased during storage. However, honey has been found to be very effective in delaying and decreasing oxidation. Moreover, chicken patties fried in palm olein oil showed better storage stability and acceptance as compared to corn oil.

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REFERENCES

Aleson-Carbonella L, Fernandez-Lopez J, Perez JA, Kuri V (2005). Characteristics of beef burger as influenced by various types of lemon albedo. Innov. Food Sci. Emerg. 6: 247-255.

Ali SW, Rasool G (2007). Chemical and sensory characteristics of frozen chicken patties fried in different vegetable oils. Pak. J. Agric. Sci. 44: 337-340.

Aljadi AM, Kamaruddin MY (2004). Evaluation of the phenolic contents and antioxidant capacities of two Malaysian floral honeys. Food Chem. 85: 513-518.

Al-Mamary M, Al-Meeri A, Al-Habori M (2002). Antioxidant activities and total phenolic of different types of honey. Nutr. Res. 22: 1041-1047.

Aluyor EO, Jesu MO (2008). The Use of Antioxidants in Vegetable Oils-A Review. Afr. J. Biotechnol. 7: 4836-4842.

Antony S, Rieck JR, Acton JC, Han IY, Halpin EL, Dawson PL (2006). Effect of dry honey on shelf life of Packaged Turkey Slices. Poult. Sci. 85: 1811-1820.

Antony S, Rieck JR, Dawson PL (2000). Effect of dry honey on oxidation in turkey breast meat. Poult. Sci. 79: 1846-1850.

AOAC, Association of Official Analytical Chemists (1995). Official Methods of Analysis. 14th ed. Washington DC, USA.
Arafa AS, Chen TC (1976). Quality characteristics of convenience chicken products as related to packaging and storage. J. Food Sci. 41: 18-22.
Arief MA, Reddy KP, Reddy VR (1989). Influence of packaging materials and storage period on certain organoleptic characteristics of broiler cut up parts. Kerala J. Vet .Sci. 20: 107-114.
Ashgar A, Lin CF, Gray JI, Buckley DJ, Boran AM, Flegal CJ (1990). Effects of dietary oils and a tocopherol supplementation on membrane lipid oxidation in broiler meat. J. Food Sci. 55: 46-50.
Belewu MA, Morakinyo OA (2009). Nutritional, microbiological and sensory evaluation of honey treated and untreated soft cheese. Eur. J. Sci. Res. 26: 124-131.
Bhat ZF, Pathak V, Bukhari SAA, Ahmad SR, Bhat H (2011). Quality changes in chevon harrisa (meat based product) during refrigerated storage. Int. J. Meat Sci. 1: 52-61.
Biswas S, Chakraborty A, Patra G, Dhargupta A (2011). Quality and acceptability of duck patties stored at ambient and refrigeration temperature. Int. J. Livestock Prod. 1: 1-6.
Bognar A (1998). Comparative study of frying to other cooking techniques influence on the nutritive value. Grasas Aceites, 49: 250-260.
Boyd LC, Green DP, Giesbrecht FB, King MF (1993). Inhibition of oxidative rancidity in frozen cooked fish flakes by tertiary-butyl hydroquinone and rosemary extract. J. Sci. Agric. 61: 87-93.
Brewer MS, Mckeith FK, Britt K (1998). Fat, soy and cariageenan effect on sensory and physical characteristics of ground beef patties. Indian J. Food Sci. 57: 1051-1055.
Brudzynski K, Miotto D (2011). The recognition of high molecular weight melanodins as the main component responsible for radical scavenging capacity of unheated and heat treated Canadian honeys. Food Chem. 125: 570-575.
Devatkal S, Mendiratta SK, Anjaneyulu ASR (2003). Effect of calcium lactate on the quality and shelf life of restructured pork rolls. J. Meat Sci. 1: 1-6.
Egbert WR, Huffman DL, Chen CC, Dulewski DP (1991). Development of low fat ground beef. J. Food Technol. 45: 64-73.
Eyas AM (2001). Studies on development of enrobed buffalo meat cutlets. M.V.Sc thesis, Indian Veterinary Res.Institute, Izatnagar, Uttar Pradesh, India.
Glitsch K (2000). Consumer Perceptions of Fresh Meat Quality: Crossnational comparison. Br. Food J. 102: 177-194.
Grau A, Guardiola F, Grimpa S, Barroeta C, Codony R (2001). Oxidative stability of dark chicken meat through frozen storage: Influence of dietary fat and α- tocopherol and ascorbic acid supplementation. Poult. Sci. 80: 1630-1642.
Greens BA, Cumuze TH (1982). Relationship between TBARS numbers and in experienced panelists' assessment of oxidized flavour in cooked beef. J. Food Sci. 4: 52-58.
Jacobson GA (1991). Quality control in deep fat frying operations. J. Food. Technol. 45: 72-74.
Jay JM (1996). Fresh meat and poultry in modern food microbiology. 5th ed. Jay JM. ed. Chapman and Hall, NW. p. 87.
Jin SK, Kim IS, Jung HJ, Kim DH, Choi YJ, Hur SJ (2007). The development of sausage including meat from spent laying hen surimi. Poult Sci. 86: 2676-2684.
Johnston JE, Sepe HA, Miano CL, Brannan RG, Alderton AL (2005). Honey inhibits lipid oxidation in ready-to-eat ground beef patties. Meat Sci. 70: 627-631.
Kahkonen MP, Hopia AI, Vuorela HJ, Rauha JP, Pihlaja K, Kujala TS, Heinonon M (1999). Antioxidant activity of plant extracts containing phenolic compounds. J. Agric. Food Chem. 47: 3954-3962.
Kerler J, Grosch W (1996). Odorants contributing to warmed over flavour (WOF) of refrigerated cooked beef. J. Food. Sci. 61: 1271-1274.
Khalil MI, Sulaiman SA (2010). The potential role of honey and its polyphenols in preventing heart diseases: A Review. Afr. J. Tradit Complement Altern. Med. 7: 315-321.
Klose AA, Pool MF, Campbell AA, Hanson HL (1959). Time temperature tolerance of frozen food. Food Technol. 13: p. 477.
Kumar KPS, Bhowmik D, Chiranjib, Biswajit, Chandira MR (2010). Medicinal uses and health benefit of Honey. An overview. J. Chem. Pharm. Res. 2: 385-395.
Lai SM, Gray JI, Smith DM, Booren AM, Crackel RL, Buckley DJ (1991). Effects of oleoresin rosemary, tertiary butylhydroquinone, and sodium tripolyphosphate on the development of oxidation rancidity in restructured chicken nuggets. J. Food Sci. 56: 616-620.
Miller AJ, Ockerman SA, Palumbe SA (1980). Effect of frozen storage on functionality of meat for processing. J. Food Sci. 50: 531-534.
Nagai T, Inoue R, Kanamori N, Suzuki N, Nagashima T (2006). Characterization of honey from different floral sources. Its functional properties and effects of honey species on storage of meat. Food Chem. 15: 256-262.
Narang D, Sood S, Thomas MK, Dinda AK, Moulik SK (2004). Effect of dietary palm olein oil on oxidative stress associated with ischemic-reperfusion injury in isolated rat heart. BMC Pharmacol. 4: 2210-2429.
Nath RL, Mahapatra CM, Kondaiah N, Anand SK, Singh JN (1995). Effect of levels of chicken fat on the quality and storage of chicken patties. Ind. J. Poult. Sci. 30: 52-57.
Olutiola, PO, Famurewa O, Sonntag HG (1991). An introduction to general microbiology: A practical approach. 1st ed, Heidelberger Verlagsanstalt and Druckerei GmbH Heidelberg. p. 267.
Ozer O, Sariçoban C (2010). The effects of butylated hydroxyanisole, ascorbic acid, and α-tocopherol on some quality characteristics of mechanically deboned chicken patty during freeze storage. Czech J. Food Sci. 28: 150-160.
Rao BJ, Reddy KP (2000). Influence of binders and refrigerated storage on the quality of chicken meat loaves. Indian J. Poult. Sci. 35: 302-305.
Saguy IS, Dana D (2003). Integrated approach to deep fat frying: engineering, nutrition, health and consumer aspects. J. Food Eng. 56: 143-152.
Sayago-Ayerdi SG, Brenes A, Goni I (2009). Effect of grape antioxidant dietary fiber on the lipid oxidation of raw and cooked chicken hamburgers. LWT. Food Sci. Technol. 42: 971-976.
Shelef LA (1975). Microbial spoilage of fresh refrigerated beef liver. J. Appl. Bacteriol. 39: 273-280.
Sotelo A, Perez L (2003). Nutritive value of chicken and potato mixtures for infant and preschool children feeding. J. Sci. Food. Agric. 83: 1205-1209.
Strange ED, Bendict RC, Smith JL, Swift GE (1977). Evaluation of rapid tests for monitoring, alteration in meat quality during storage. J. Food Prot. 40: 843-847.
Tuley (1989). Don't forget the honey. Food Manuf. 64: 24-25.
USDA (2007). USDA National Nutrient Database for Standard Reference, Release 24. http://www.nal.usda.gov/fnic/foodcomp/cgi-bin/list_nut_edit.pl
Wan Rosli WI, Solihah MA, Mohsin SSJ (2011). On the ability of oyster mushroom (Pleurotus sajor-caju) conferring changes in proximate composition and sensory evaluation of chicken patty. Int. Food Res. J. 18: 1463-1469.
Winger RJ, Hagyard C (1994). Juiciness- its importance and some contributing factors. In: Pearson AM, Dutson TR, editors. Quality attributes and their measurement in meat, poult. and fish products. Blackie Academic and Professional, London. pp. 94-124.