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THE EFFECTS OF ONION SKIN POWDER ON THE QUALITY OF COOKED CHICKEN MEAT PATTIES DURING REFRIGERATED STORAGE

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In this study, the effects of onion skin powder (OSP) (0, 1.5, 3.0, and 6%) on some chemical and physical properties of cooked chicken meat patties during refrigerated storage (30 days, 4±1 °C) were investigated. For this purpose, moisture, fat, pH, free fatty acid (FFA), and thiobarbituric acid (TBA) analyses in the raw meat patties were also carried out. In addition, the chemical (moisture, fat), technological (diameter reduction, cooking yield), and sensory properties of cooked chicken patties were examined on the first day of storage. During storage, pH, colour, FFA, and TBA analyses were performed.

There were significant changes in the physical, chemical, technological, and sensory properties of chicken patties with OSP addition. The moisture, pH, and TBA values of samples decreased by incorporated OSP. Moreover, the use of OSP improved technological parameters of patties. However, the addition of OSP resulted in a darker colour in patties. In conclusion, OSP could be used in chicken meat patties to improve their quality properties.

Keywords: onion skin, chicken meat, patty

The demand for healthy and nutritious food has gradually increased because of better understanding of the relationships between diet and health. For this reason, many functional products have been improved and commercialized in recent years. Since meat is one of the widely consumed fast foods, meat-based functional foods are also seen as an opportunity to meet consumer needs and update nutritional goals (Cox & Abu-Ghannam, 2013). The quantity and quality of non-meat ingredients in meat products formulations is one of the most significant factors affecting the quality of the product (Kurt & Kilincceker, 2012). Patties formulations may contain one or more non-meat ingredients consisting of fruit, vegetable, and cereal products (Kurt, 2015). Plant products are frequently used to enhance technological, economic, sensory, and nutritional characteristics of meat products (Cox & Abu-Ghannam, 2013). It is known that plant products containing dietary fibre have effects such as tissue improvement, increasing yield, and cost reduction in meat products (Guedes-Oliveria et al., 2016).

Onion (*Allium cepa* L.) is the second most important horticultural product after tomato (Benitez et al., 2011). A significant amount of onion waste is produced in the food industry, and there is a serious concern about its utilization (Roldan et al., 2008). Onion wastes are not proper for animal feed due to the characteristic flavour (Benitez et al., 2011) and their tendency to promote growth of phytopathogenic agents (Roldan et al., 2008). In addition, these wastes affect the odour of the soil by decay, and they harm the environment (Bello et al., 2013). Onion skin is one of the most important onion wastes (Bello et al., 2013), and it

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is a great resource for quercetin and its derivatives (Swieca et al., 2013). The inedible part of the onion is reported to contain 77 times more quercetin than the edible part (Ko et al., 2011). Quercetin has antimicrobial, anti-inflammatory, and anti-carcinogenic properties (Swieca et al., 2013). In addition, onion skin is known to have high insoluble dietary fibre content and antioxidant properties (Benitez et al., 2011).

The studies about the use of onion skin in food products as ingredient are limited. Chung et al. (2018) studied the effects of onion skin and black currant powder on the physicochemical and storage characteristics of Hanwoo Tteokgalbi (a traditional food in Korea). In another study (Gawlik-Dziki et al., 2013), the effect of onion skin on sensory and antioxidant properties of bread was examined, and it was reported that the addition of 2–3% onion skin significantly increased the antioxidant capacity of bread. The effects of onion skin powder on the physical, chemical, and sensory properties of raw and cooked chicken meat patties were investigated by our research group (Kurt & Ceylan, 2017). The purpose of this study is to investigate the effects of onion skin powder on the physical, chemical, colour and sensory properties of chicken meat patties during refrigerated storage.

1. Materials and methods

1.1. Materials

Chicken meat and beef fat were supplied from a local market (Adıyaman, Turkey). Other ingredients were obtained from the local spice store (Gaziantep, Turkey).

1.2. Preparation of onion skin powder

The onion skins were washed with running water, washed twice with distilled water, then dried in an oven at 50 °C. The dried onion skin was powdered using a laboratory grinder and then sieved using a sifter (0.5 mm diameter).

1.3. Preparation of chicken meat patties

Patty formulation is shown in Table 1. Chicken and beef fat were cut and all ingredients were minced in a meat grinder (Tefal, Le Hachoir 1500, France). The mixture was divided into 4 equal parts and 0, 1.5, 3.0, and 6% onion skin powder (OSP) was respectively added to each portion. Then, the mixture was again chopped in a meat grinder (a 3 mm diameter hole plate). Next, each 25 g of batter were shaped with silicone moulds (1.4 cm thick and 4.8 cm in diameter). The patties were cooked in an oven (Wiseven Won 155, Korea) at 180 °C for 15 min. Cooked patties were stored at 4±1 °C for 30 days and analyses were periodically carried out.

1.4. Chemical analyses of patties

The pH values were measured using a pH meter as recommended by Ockerman (1985). Moisture and fat analyses were carried out according to AOAC (2000). The free fatty acid (FFA) and TBA (thiobarbituric acid) analyses were performed according to Egan and co-workers (1981) and Tarladgis and co-workers (1960), respectively.

Table 1. Formulation of chicken meat patties

Materials	Formulation (%)
Chicken breast meat	77.0
Beef fat	16.5
Salt	1.5
Onion powder	1.7
Cumin	0.3
Red pepper powder	1.2
Black pepper	0.3
Bread crumbs	1.5

1.5. Yield, dimension, and colour analysis

The cooking yield and diameter reduction values of samples were determined according to KURT (2015). The colour values of cooked samples were measured by a portable colorimeter (Minolta Cr400, Osaka, Japan).

1.6. Sensory analysis

The sensory properties of patties were evaluated using a hedonic scale by ten panellists (1=dislike extremely, 9=like very much).

1.7. Statistical analysis

The data were subjected to analysis of variance (ANOVA). The difference between samples was determined by Duncan multiple-range test.

2. Results and discussion

2.1. The effects of onion skin powder on the chemical properties of chicken meat patties

The chemical properties of patties formulated with different levels of OSP are demonstrated in Tables 2 and 3. It is seen that the highest moisture content in raw and cooked patties was determined for control samples ($P<0.05$). The addition of OSP resulted in a reduction in the moisture content of the patties. ELHADIA and co-workers (2017) reported similar results for chicken patties with *Moringa oleifera* leaf powder. On the other hand, the effect of OSP on the fat content of raw and cooked samples was not found to be significant ($P>0.05$).

Table 2. The effects of OSP on the moisture and fat values of chicken meat patties (mean±standard deviation)

OSP (%)	Raw		Cooked	
	Moisture (%)	Fat (%)	Moisture (%)	Fat (%)
0.0	61.06±0.88 ^{a}	16.31±0.21 ^{a}	54.36±0.69 ^{a}	15.55±0.90 ^{a}
1.5	60.02±0.06 ^{ab}	16.21±0.37 ^{a}	53.37±0.30 ^{ab}	16.38±0.52 ^{a}
3.0	58.97±0.21 ^{bc}	15.73±0.79 ^{a}	52.64±0.25 ^{b}	16.32±0.09 ^{a}
6.0	57.57±0.62 ^{c}	14.64±1.00 ^{a}	51.20±0.14 ^{c}	15.82±0.16 ^{a}

OSP: Onion skin powder

$^{a-c}$: Different lowercase letters in a column show significant differences between the groups ($P<0.05$).

The pH value of raw and cooked samples decreased as the OSP content increased ($P<0.05$). This reduction in pH values may be due to the low pH value of the OSP. Also, the cooking process slightly increased the pH value in all formulations. This can be explained by the formation of peptides and amino acids due to protein hydrolysis or loss of short-chain organic acids during cooking (Mbougueng et al., 2017). The pH values of samples slightly increased at the end of the storage, nevertheless, the increase was not significant ($P>0.05$).

Table 3. The effects of OSP on the chemical properties of raw and cooked chicken meat patties during storage (mean±standard deviation)

OSP (%)	Before cooking	After cooking			
		Day 0	Day 10	Day 20	Day 30
pH					
0.0	6.17±0.09 ^{a}	6.36±0.02 ^{aA}	6.37±0.10 ^{aA}	6.20±0.08 ^{aA}	6.74±0.15 ^{aA}
1.5	5.99±0.03 ^{b}	6.24±0.01 ^{bA}	6.33±0.04 ^{aA}	6.21±0.14 ^{aA}	6.38±0.16 ^{bA}
3.0	5.82±0.05 ^{c}	6.06±0.06 ^{cAB}	6.24±0.06 ^{aAB}	6.19±0.03 ^{aA}	6.30±0.08 ^{bB}
6.0	5.65±0.02 ^{d}	5.73±0.03 ^{dA}	5.80±0.09 ^{bA}	5.84±0.00 ^{bA}	5.91±0.00 ^{cA}
FFA					
0.0	0.66±0.09 ^{a}	0.71±0.11 ^{aA}	0.74±0.07 ^{aA}	0.98±0.19 ^{aAB}	1.22±0.11 ^{aB}
1.5	0.70±0.00 ^{a}	0.80±0.15 ^{aA}	0.88±0.01 ^{bAB}	1.06±0.06 ^{aB}	1.59±0.09 ^{bC}
3.0	0.63±0.12 ^{a}	0.85±0.11 ^{aA}	0.93±0.00 ^{bA}	1.24±0.03 ^{abB}	1.71±0.11 ^{bcC}
6.0	0.67±0.13 ^{a}	0.80±0.05 ^{aA}	1.08±0.06 ^{cA}	1.58±0.18 ^{bB}	1.94±0.09 ^{cC}
TBA					
0.0	0.132±0.069 ^{a}	0.231±0.029 ^{aA}	0.212±0.034 ^{aA}	0.195±0.042 ^{aA}	0.167±0.045 ^{aA}
1.5	0.092±0.018 ^{a}	0.102±0.011 ^{bA}	0.092±0.009 ^{bA}	0.091±0.011 ^{bA}	0.079±0.006 ^{bA}
3.0	0.080±0.008 ^{a}	0.085±0.008 ^{bA}	0.075±0.006 ^{bA}	0.087±0.026 ^{bA}	0.074±0.008 ^{bA}
6.0	0.077±0.003 ^{a}	0.094±0.016 ^{bA}	0.068±0.011 ^{bA}	0.077±0.009 ^{bA}	0.064±0.016 ^{bA}

OSP: Onion skin powder
$^{a-d}$: Different lowercase letters in a column show significant differences between the groups ($P<0.05$).
$^{A-C}$: Different uppercase letters in a row show significant differences between the groups ($P<0.05$).

While the OSP was not found to have any effect on the FFA and TBA values of raw samples ($P>0.05$), the effect of OSP on FFA and TBA values of cooked samples was significant ($P<0.05$). The addition of OSP caused a significant increase in FFA values of samples from the 10th day of storage. Furthermore, data indicated that cooking process caused a slight increase in FFA values and FFA values of samples at the end of storage. As a result of cooking, there was a slight increase in TBA values of samples. While the highest TBA values were detected in control samples, the TBA values of other samples were similar at all stages of storage. Similarly, Ozturk and co-workers (2014) stated that TBA formation in patties containing wheat sprout powder was reduced when compared to control sample. Moreover, the fluctuation in TBA values of the samples during storage was not statistically significant ($P>0.05$).

2.2. The effect of onion skin powder on technological properties of cooked patties

Technological properties must also be considered when evaluating the benefits of additives. The diameter reduction and cooking yield values of cooked patties are shown in Table 4. The effect of OSP on the technological properties of cooked beef patties was found to be significant ($P<0.05$). It can be attributed to the dietary fibres of OSP. It is known that onion skin contains considerable amounts of dietary fibres (Benitez et al., 2011).

Shrinkage is a substantial parameter in patties, and extreme shrink in patties is undesired (Turhan et al., 2009). The addition of OSP at levels 3.0 and 6.0% to formulation was effective against shrinkage ($P<0.05$). This can be attributed to the behaviour of OSP fibres and moisture holding capacity of OSP. In addition, cooking yield increased with OSP addition. While the cooking yield was 81.51% in the control group, it was 87.24% in sample containing 6% OSP. These results supported the findings of Chung and co-workers (2018) in Hanwoo Tteokgalbi containing OSP. On the other hand, Kurt and Ceylan (2017) stated that OSP had no effect on the technological parameters of the chicken beef patty.

Table 4. The effects of OSP on the technological properties of cooked chicken meat patties (mean±standard deviation)

OSP (%)	Dimension reduction (%)	Cooking yield (%)
0.0	14.83±0.13 ^{a}	81.51±1.43 ^{c}
1.5	14.10±1.00 ^{a}	82.76±1.41 ^{bc}
3.0	12.78±1.00 ^{ab}	85.30±0.88 ^{ab}
6.0	11.07±1.03 ^{b}	87.24±0.92 ^{a}

OSP: Onion skin powder

$^{a-c}$: Different lowercase letters in a column show significant differences between the groups ($P<0.05$).

2.3. The effect of onion skin powder on colour properties of cooked patties

L, a, and *b* values of cooked beef patties during storage are shown in Table 5. The effect of OSP on the colour properties of cooked patties was significant ($P<0.05$) at all stages of storage. The highest *L* value was observed in the control sample, while addition of OSP with different levels resulted in decrease in *L* values of the samples at all stages of storage. This could be attributed to the fact that onion skin is darker than chicken meat. Kim and co-workers (2013) reported that the addition of dietary fibre extracts from brewer's spent grain caused a decline in the lightness value of chicken patties. At any time of storage, the *a* values of samples incorporated with 3.0 and 6.0 OSP were significantly higher. Chung and co-workers (2018) stated that redness value of Hanwoo Tteokgalbi containing 0.6% OSP was higher than that of the sample containing 0.6% black currant powder. Similarly, *b* values of patties increased with the addition of different concentrations of OSP at all stages of storage. These changes in the colour properties of the patties might be due to the colour pigments of the OSP. Furthermore, *L* values of samples increased ($P<0.05$) at the end of storage, whereas *a* and *b* values of samples decreased ($P<0.05$).

Table 5. The effects of OSP on the colour properties of cooked chicken meat patties during storage (mean±standard deviation)

OSP (%)	Day 0	Day 10	Day 20	Day 30
L				
0.0	47.15±0.28 ^{aA}	53.10±1.36 ^{aB}	54.71±0.98 ^{aBC}	54.12±0.40 ^{aBC}
1.5	43.94±0.83 ^{bA}	48.86±1.13 ^{bB}	52.40±0.75 ^{bC}	50.96±0.35 ^{bBC}
3.0	40.41±0.17 ^{cA}	48.00±1.92 ^{bB}	48.78±0.30 ^{cB}	47.29±0.74 ^{cB}
6.0	38.17±0.41 ^{dA}	42.92±0.27 ^{cB}	43.32±0.07 ^{dB}	43.53±0.59 ^{dB}
a				
0.0	8.81±0.28 ^{aA}	6.86±0.53 ^{aB}	6.58±0.09 ^{aB}	6.27±0.39 ^{aB}
1.5	9.15±0.08 ^{aA}	7.23±0.67 ^{abB}	6.65±0.04 ^{aB}	6.52±0.18 ^{aB}
3.0	10.39±0.63 ^{bA}	8.36±0.02 ^{bB}	7.69±0.34 ^{bB}	7.85±0.63 ^{bB}
6.0	11.47±0.31 ^{cA}	10.60±0.37 ^{cB}	10.35±0.21 ^{cB}	10.54±0.07 ^{cB}
b				
0.0	21.03±0.28 ^{aA}	19.28±0.47 ^{aB}	19.43±0.11 ^{aB}	19.20±0.63 ^{aB}
1.5	18.24±0.34 ^{bA}	17.05±0.09 ^{bB}	17.43±0.26 ^{bB}	17.63±0.20 ^{bAB}
3.0	15.83±0.18 ^{cA}	16.42±0.06 ^{bcB}	16.83±0.22 ^{cC}	16.50±0.03 ^{cBC}
6.0	14.49±0.33 ^{dA}	15.70±0.06 ^{dB}	15.58±0.19 ^{dB}	15.86±0.10 ^{cdB}

OSP: Onion skin powder
$^{a-d}$: Different lowercase letters in a column show significant differences between the groups ($P<0.05$).
$^{A-C}$: Different uppercase letters in a row show significant differences between the groups ($P<0.05$).

Table 6. The effects of OSP on the sensory properties of cooked chicken meat patties (mean±standard deviation)

OSP (%)	Appearance	Colour	Odour	Texture	Flavour	Overall acceptability
0.0	5.05±0.07 ^{b}	4.45±0.07 ^{d}	5.80±0.14 ^{a}	6.10±0.00 ^{a}	5.85±0.50 ^{ab}	5.95±0.07 ^{b}
1.5	6.50±0.28 ^{a}	5.50±0.14 ^{c}	5.90±0.00 ^{a}	6.25±0.21 ^{a}	6.60±0.28 ^{a}	6.60±0.28 ^{a}
3.0	6.45±0.21 ^{a}	6.80±0.14 ^{a}	5.45±0.07 ^{ab}	5.65±0.07 ^{b}	5.35±0.21 ^{b}	5.85±0.21 ^{b}
6.0	5.65±0.35 ^{b}	6.00±0.14 ^{b}	5.10±0.28 ^{b}	4.95±0.21 ^{c}	4.25±0.21 ^{c}	4.95±0.07 ^{c}

OSP: Onion skin powder
$^{a-d}$: Different lowercase letters in a column show significant differences between the groups ($P<0.05$).

2.4. The effect of onion skin powder on sensory properties of cooked patties

The sensory evaluation of the beef patties containing different OSP levels is indicated in Table 6. As shown in Table 6, treatment with OSP affected significantly ($P<0.05$) the sensory features of chicken meat patties. Nardoia and co-workers (2017) stated that the addition of grape by-products significantly affected the sensory colour and overall acceptability scores of chicken patties. The highest score in appearance was found in patties containing 1.5% and 3.0% OSP. The panellists positively evaluated the addition of OSP to the formulation in terms of colour. The highest score in colour was given to sample containing 3.0% OSP. Nevertheless, panellists negatively evaluated the addition of 3.0 and 6.0% OSP in terms of odour, texture,

and flavour. The sample containing 1.5% OSP had the highest overall acceptability score, whereas the samples containing 6.0% OSP had the lowest. When all sensory scores are considered, the addition of 6.0% OSP negatively affected sensory properties of patties.

3. Conclusions

There were remarkable changes in the physical, chemical, technological, and sensory properties of chicken patties with OSP addition. The use of OSP caused reduction in moisture content and pH of patties. In addition, the samples with OSP were darker, more reddish and yellowish than control samples. Although TBA formation in samples containing OSP was lower than in control samples at all stages of storage, OSP increased FFA values from the 10th day of storage. The treatment of OSP in formulation improved the technological properties of patties. Nevertheless, the addition of 6.0% OSP negatively affected sensory properties. As a result, OSP can be considered as a natural and functional food additive and has a potential to be incorporated into some meat products such as chicken meat patties.

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