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Development of chicken patties incorporated with onion (*Allium cepa*) and beet root *(Beta vulgaris)* extract powder

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ABSTRACT

Meat and meat products are dense source of nutrients, having health and industrial importance. However nutrient rich meat and its products have low stability even at low temperature. Application of natural antioxidants to perishable food product for enhancing stability is an innovative concept. Therefore the present study was planned to develop chicken patties incorporated with different levels 0.75, 1.5 and 2.25% of onion or beet root extract powder. From the study, it is observed that the pH and cooking yield values were decreased significantly in onion and beetroot extract treated patties respectively. Moisture, fat, protein content decreased significantly (P<0.05), however ash content increased with increase in the level of onion and beetroot extract incorporation in chicken patties. Sensory study revealed that the 1.5% onion and beet root extract powder treated chicken patties had significantly (P<0.05) higher sensory scores for all attributes than control and other treatments, showing liking of consumers for 1.5% onion extract powder treated patties.

Key words: Antioxidants, shelf life, chicken patties, onion extract powder, beetroot extract powder

INTRODUCTION

Communited meat products viz, nuggets patties, sausage are homogenous mixture of proteins, fat particles, water, salt and carbohydrates obtained by processing viz, mincing, emulsification, cooking, etc. Recently consumers are demanding for ready to eat meat products due to global urbanization, change in food habits as well as lifestyle, innovations in cooking technologies, women employment and higher income generation (Muthukumar and Naveena, 2019). Chicken meat is a lean meat available at affordable cost having higher concentration of PUFA (Bourre 2005) which exhibits health benefits. Chicken patty is a most popular ready to eat meat product, comprising industrial and economic importance. It is commonly used as a filling for burger rolls or sandwiches as well as to eat with tomato sauce or chutney. These could be made easily available in the meat parlour, meat outlets to cater to the demand of consumers.

Onion (*Allium cepa* L.) is a spice belongs to the family, *Amaryllidaceae* and the *genus Allium,* which is grown as main crop especially in the Asia. Onions are very low in calories having only 40 calories per 100 grams. As per USDA Nutrient Data base 2014, onion contains 1.1 grams protein, 9.3 grams carbohydrates, 1.7 grams fibre, 0.1

grams fat. Onion is also a good source of vitamin C, Folate, Vitamin B6, and Potassium (Mahmood et al. 2021). Onion is a decent source of fibre, with a dominance of healthy soluble fibres called fructans. Fructans are prebiotic fibres, which fed the beneficial gut bacteria, leading in formation of short-chain fatty acids, such as butyrate, as it helps to improve colon health, reduce inflammation and minimizes risk of colon cancer (Jaime et al. 2002). Red onion is also a potent source of anthocyanin pigment, quercetin, Sulfur-containing compounds and flavonoids f and their glycosides (Ashwini et al. 2013). Presence of quercetin and flavonoids in onion lowers blood pressure and improve heart health (Mahmood et al. 2021) while availability of sulfur-containing compounds, flavonoids and their excellent photochemistry property reduces risk of cardiovascular diseases, diabetes, cancer and atherosclerosis (Suleria et al. 2015). Therefore daily intake of onion is potentially good for human health (Zhang et al. 2016).

Beetroot (*Beta vulgaris*) belongs to the family *Beta vulgaris subsp. vulgaris conditiva,* and a genus of *Edible taproots*. Beet root generally comes to dining table in the form of salad or juice. It is a rich source of carbohydrates, proteins, lipids, dietary fiber, sugars and micro minerals such as potassium, sodium, phosphorous, calcium, magnesium, copper, iron, zinc and manganese (Singh et al. 2014). It is also an abundant source numerous biologically active phytochemicals including betalains, flavonoids, polyphenols, saponins are available in abundant amount in beetroot (Baiao et al. 2017). Betalain is water-soluble nitrogenous plant pigments containing betacyanins; red pigment and betaxanthins; yellow pigment. Color intensity of beetroot is depends on the ratios of these pigments. Therefore, beetroot may be used as a colorant or additive in food products (Chhikara et al. 2019). Beetroot has a prospective in health promotion due to its anti-oxidant and anti-inflammatory (Georgiev et al. 2010), anti-carcinogenic, anti-diabetic, hepato-protective, hypotensive, and wound healing properties (Domínguez et al. 2017). Considering the demand for convenience food as well as health benefits and nutrient content of onion and beet root powder the present study is undertaken to develop acceptable quality chicken patties with incorporation of health beneficial onion extract powder and beet root extract powder.

MATERIAL AND METHODS

The study was conducted in the Department of Livestock Products Technology, College of Veterinary and animal Sciences, Parbhani. Raw chicken meat of 6 weeks old chicken obtained within 1-2 h of slaughter from authorized retail meat shop of Parbhani city. It is packed in pre-sterilized low-density polyethylene (LDPE) bags and brought to the laboratory within 20 min. The meat was deboned, trimmed-off separable fat and connective tissue. It was kept for conditioning in a refrigerator at 4±1°C for 6-8 hrs and then frozen at -18±2°C till further use. Food grade refined vegetable oil (Fortune VR), food grade sodium tripolyphosphate (Hi Media Laboratories (P) Ltd, Mumbai), salt, condiments, refined wheat flour were purchased from the local market of Parbhani. For the preparation of the spice mix, ingredients were procured from the local market, weighed (Table 1), dried at 45±2°C for 2 hrs followed by grinding and sieving through the mesh. The spice mix was stored in pre-sterilized low- density polyethylene bags and used as per requirement given in formulation (Table 3). All chemicals used in the study were of analytical grade and procured from standard firms like Hi Media Laboratories (P) Ltd, Mumbai.

Table 1: Composition of spice mix

Sr. No.	Ingredients	Quantity (% by weight)
1	Cloves (Laung)	2
2.	Coriander (*Dhania*)	20
3.	Capsicum (*Mirch*)	11
4.	Cumin seeds (*Zeera*)	20
5.	Turmeric (*Haldi*)	5
6.	Cinnamon (*Dalchini*)	5
7.	Aniseed (Soanf)	12
8.	Black papper (Kali mirch)	8
9.	Caraway seed (Ajowan)	8
10.	Nutmeg (*Jaiphal*)	3
11.	Caradamom (Badi elaichi)	5
12.	Small cardamom (*Sabze-laichi*)	1
Total		**100**

Natural Antioxidants

Onion (*Allium cepa*) and beetroot (*Beta vulgaris*) extract powder with their physico-chemical properties (Table 2) was supplied by M/s from 'World of Nature' B1104, Balewadi, Banwer, pune 411045, India.

Table 2: Physico-chemical properties of onion and beetroot extract powder

Content	Onion extract powder	Beetroot extract powder
Moisture %	9.5	8.03
Protein %	1.1	1.10
Fat %	0.3	0.3
Ash %	2.94	2.8
pH	4.47	5.06
Acidity	0.41	0.014

Preparation of chicken meat patties

The chicken meat patties were prepared as per method followed by Chappalwar et al. (2020[a]) (Fig.1). Frozen deboned meat was thawed at refrigeration temperature overnight. Thawed lean meat was cut into smaller chunks and minced in meat mincer with 6 mm plate followed by 4 mm plate. Fine emulsion was prepared in bowl chopper with addition of common salt, vegetable oil, refined wheat flour (maida), sodium tripolyphosphate, spice mixture condiment mix and other ingredients. Temperature of emulsion was maintained below 18°C with addition of crushed ice, preparation of emulsion in cool hours as well as mixing of meat and other ingredients in chilled/partially thawed form. Preliminary trials were conducted to optimize the level of onion and beetroot extract powder in the formulation of f chicken patties. Chicken patties were developed with incorporation of different levels viz, 0.75 and 1.5%, 2.25 % of onion and beetroot extract powder separately. The best variant was selected on the basis of physicochemical and sensory properties of chicken patties. The formulation used for preparation of chicken patties is given in Table 3.

Moulding and cooking of patties

About 50 g of emulsion was moulded on steel plate with circular ring (55 mm diameter and 20 mm height). The height and diameter of the patty was determined by vernier callipers. Patties were cooked in a pre-heated convection oven at 160°C for 15 minutes (Chappalwar et al. 2020[a]) after which they were turned upside down and cooked for another 5 min for adequate doneness and to improve the appearance and colour. Core temperature (165°F/74°C) was measured by using a probe thermometer (Labware Scientific, Inc, USA). Developed patties were subjected to analysis of physicochemical and sensory properties of chicken patties.

Analytical procedures

Proximate composition:

The moisture, fat and protein contents of fried quail meatballs were determined by following standard methods of AOAC (1995).

pH

The pH of chicken patties was determined by homogenizing 10 g of sample with 100 ml of distilled water (Trout et al. 1992) for one minute at 3000 rpm in a homogenizer. The pH values were measured using a standardized electrode attached to a digital pH meter (Systronics, μ pH system 361) calibrated with buffers of pH 7.0 and 4.0.

Cooking yield

The weight of chicken patties was recorded before and after cooking. The cooking yield was calculated as under and expressed in percentage (Murphy et al. 1975).

$$\text{Cooking yield \%} = \frac{\text{Weight of cooked chicken patties}}{\text{Weight of raw chicken patties}} \times 100$$

Sensory evaluations

A semi trained sensory panel of seven judges having academic staff members and post graduate students of the College of Veterinary and Animal Sciences, Parbhani were evaluated the quality of chicken patties by using 8 point

Table 3: Formulation used for preparation of chicken patties

Sr. No.	Ingredient	Control	T1	T2	T3
1	Chicken	70	69.25	68.50	67.75
2	Refined vegetable oil	8	8	8	8
3	Ice flakes	8	8	8	8
4	Salt	1.5	1.5	1.5	1.5
5	Dry spices mix	2.0	2.0	2.0	2.0
6	Condiments	3.0	3.0	3.0	3.0
7	Refined wheat flour	3.0	3.0	3.0	3.0
8	Whole eggs	4.2	4.2	4.2	4.2
9	STPP	0.3	0.3	0.3	0.3
10	Onion/ beet root extract power	-	0.75	1.5	2.25
	Total	**100**	**100**	**100**	**100**

*Chicken patties were developed with incorporation of different levels viz, 0.75 and 1.5%, 2.25 % of onion and beetroot extract powder separately. The best variant was selected on the basis of physicochemical and sensory properties of chicken patties.

descriptive scale (Keeton 1983) for different sensory attributes viz., color and appearance, flavour, juiciness, texture and overall acceptability.

Statistical analysis

The data obtained in the study on various parameters were statistically analysed on "SPSS-16.0" software package for one way ANOVA as per standard methods of Snedecor and Cochran (1994). Duplicate samples were drawn for each parameter and the experiment was replicated thrice (n = 6). Sensory evaluation was performed by a panel of seven-member judges three times, so total observations being 21 (n = 21). Data were subjected to one-way analysis of variance, homogeneity test and means were compared by using Dunkan's (1995) multiple range tests to find the effects between samples.

RESULT AND DISCUSSION

Efficacy of chicken patties incorporated with different levels of onion extracts powder.

The observations for physico-chemical properties and various sensory attributes of chicken patties incorporated with different levels of onion extract powder are presented in Table 5

pH

The pH values of chicken patties decreased gradually with increased level of onion extract powder. As per Ahmed et al. (2001) onion has low pH (3.9) and high acidity 0.41% which is the fact behind reduction of pH values in treatment chicken patties. Similar decreasing trend in pH value was observed by Kurt et al. (2019) for onion skin powder treated chicken patties.

Cooking yield

Cooking yield of chicken patties decreased marginally with incorporation of onion extract powder. This decrease in the cooking yield may be attributed to the decrease in the pH which may be responsible for decrease in the water-holding capacity. Chappalwar et al., (2020) also observed decrease in cooking yield with increased level of mango peel powder in chicken patties.

Proximate composition

The study revealed that the moisture, protein and fat content decreased significantly (P<0.05) with increased level of onion extract powder in chicken patties. Control and OE3 patties had significantly (P<0.05) higher and lower moisture content than other treatments respectively; however, there was no significant difference in moisture content of OE1 and OE2 patties. The possible reason for decrease in moisture content of treatment patties might be the addition of onion extract in powder form and low pH value of treatment patties resulting in lower water-holding capacity. Protein and fat content of chicken patties differed significantly (P<0.05) between control and treatments. Kumar et al. (2015) also observed significant (P<0.05) decreased protein and fat content along with increased ash content

Table 5: Quality parameters (Mean ± SD) of chicken patties incorporated with different levels of onion extract powder.

Parameters	C	OE1	OE2	OE3
	Physico-chemical properties			
pH	6.24±0.01^{a}	6.24±0.01^{a}	6.13±0.01^{b}	6.04±0.01^{c}
Cooking yield (%)	85.29±2.36	84.47±2.73	83.46±0.78	83.10±0.29
Moisture (%)	62.95±0.04^{a}	61.32±0.12^{b}	61.09±0.03^{b}	60.45±0.16^{c}
Protein (%)	19.77±0.08^{a}	19.23±0.09^{b}	18.42±0.09^{c}	18.07±0.02^{d}
Fat (%)	17.36±0.02^{a}	17.21±0.02^{b}	17.03±0.12^{c}	16.40±0.18^{d}
Ash (%)	3.47±0.12^{d}	3.63±0.05^{c}	4.09±0.02^{b}	4.14±0.01^{a}
	Sensory attributes			
Color and appearance	6.85±0.15^{ab}	7.19±0.16^{a}	7.23±o.15^{a}	6.47±0.11^{b}
Flavour	6.85±0.14^{b}	7.19±0.11^{a}	7.38±0.22^{a}	7.09±0.06^{ab}
Juiciness	7.28±0.17	7.14±0.17	7.00±0.16	6.95±0.17
Texture	6.52±0.14	6.66±0.14	6.90±0.18	6.61±0.10
Overall Acceptability	6.47±0.11^{c}	7.19±0.11^{b}	7.57±0.11^{a}	7.14±0.14^{b}

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)

C (control)- chicken patties without any antioxidant, OE1- chicken patties incorporated with 0.75% onion extract powder, OE2- chicken patties incorporated with 1.50 % onion extract powder and OE3- chicken patties incorporated with 2.25 % onion extract powder.

in dried carrot powder incorporated chicken cutlets. Ash content was increased significantly (P<0.05) at each level of incorporation of onion extract powder which could be due to addition of high mineral containing onion extract powder in formulation (Table 2). Michalak-Majewska et al. (2020) recorded good amount of ash (5.50–5.93%) content in the onion skin and increase in ash content on incorporation it in pasta samples. Similar findings were reported by Kashyap et al. (2012) for ginger paste, tomato paste and aloe vera gel incorporated chicken meat patties. Kumar et al. (2015) also observed significant (P<0.05) decreased protein and fat content along with increased ash content in dried carrot powder incorporated chicken cutlets.

Sensory evaluation

Sensory scores for colour and appearance, flavour and overall acceptability increased significantly (P<0.05) upto OE2, thereafter these score were decreased significantly (P<0.05) in OE3. Higher colour and appearance scores in onion extract treated patties might be due to improvement in color of chicken patties on incorporation of onion extract powder at certain level, and bestowed color of red meat product due to the presence of anthocyanins and anthoxanthins in onion extract powder. Gadekar et al. (2014) also found higher color and appearance scores in natural antioxidant treated restructured goat meat products than control. Bedrnicek et al. (2020) noticed comparable darker colour in onion peel powder added fish sausages than control. Pleasant flavour of onion contribute to presence of trace concentrations of sulphur and alk(en)yl cysteine sulphoxides (Benitez et al. 2011), resulting in a marginal increase in flavour score of onion extract powder incorporated chicken patties. There was no significant difference for texture and juiciness scores between control and onion extract powder treated patties. In present study, significantly (P<0.05) higher overall acceptability score for OE2 patties than control and other treatments might be due to higher perception of sensory panellist for all sensory attributes. Present findings are in close agreement with Kurt et al. (2019) who recorded significantly (P<0.05) higher sensory scores for 1.5% onion skin powder treated chicken meat patties than control and other treatments. Bedernick et al. (2020) and Zargar et al. (2017) observed higher consumers perception for onion peel powder and carrot powder incorporated fish and chicken sausages than control respectively.

Efficacy of chicken patties incorporated with different levels of beet root extract powder

The observations for physico-chemical properties and various sensory attributes of chicken patties incorporated with different levels of beet root extract powder are presented in Table 6.

Physico-chemical properties

Result revealed marginal decrease in the pH value of chicken patties on incorporation of beet root extract powder. Lower pH values in treatments than control patties might be due to acidic nature of beet root extract

Table 6: Quality characteristics (Mean ± SD) of chicken patties incorporated with different levels of beet root extract powder.

Parameters	C	BE1	BE2	BE3
Physicochemical properties				
pH	6.26±0.10	6.19±0.18	6.09±0.34	6.01±0.32
Cooking yield (%)	85.26±0.32^{a}	83.94±0.12^{b}	82.93±0.57^{c}	80.77±0.31^{d}
Moisture (%)	62.98±0.05^{a}	62.41±0.11^{a}	61.74±0.29^{b}	61.43±0.22^{b}
Protein (%)	19.69±0.12^{a}	19.44±0.12^{a}	18.29±0.06^{b}	18.16±0.35^{b}
Fat (%)	14.05±0.19^{a}	13.90±0.02^{ab}	13.68±0.04^{bc}	13.41±0.04^{c}
Ash (%)	3.29±0.05^{c}	3.46±0.01^{b}	3.54±0.04^{b}	3.86±0.06^{a}
Sensory attributes				
Appearance	6.57±0.14^{b}	6.80±0.17^{b}	7.33±0.14^{a}	6.00±0.14^{c}
Flavour	6.95±0.04^{b}	7.04±0.08^{ab}	7.28±0.10^{a}	6.42±0.13^{c}
Juiciness	7.09±0.18	6.95±0.18	6.85±0.17	6.76±0.18
Texture	6.76±0.18	6.47±0.11	6.42±0.14	6.14±0.14
Overall Palatability	6.95±0.10^{b}	7.09±0.09^{b}	7.47±0.14^{a}	6.61±0.10^{c}

Overall means bearing different superscripts in a row (a, b, c, d…) differ significantly (P<0.05)
C (control)- chicken patties without any antioxidants, BE1- chicken patties incorporated with 0.75% beetroot extract powder, BE2- chicken patties incorporated with 1.50 % beetroot extract powder and BE3- chicken patties incorporated with 2.25 % beetroot extract powder.

powder (Table 2) than chicken meat. Similarly, Swastike et al. (2020) observed significantly (P<0.05) lower pH value for beet root powder treated sausage. Contrarily, Jin et al. (2014) observed higher pH values for red beet powder pork incorporated sausage than controls.

The cooking yield of the product decreased significantly (P<0.05) among treatments at each level. Significant decrease in cooking yield with incorporation of beet root extract might be due to replacement of lean meat with beet root extract powder. Naveena et al. (2008) observed decreased cooking yield in pomegranate juice and pomegranate rind powder extract incorporated chicken patties than control. Chappalwar et al. (2020[b]) also reported decrease in cooking yield on addition different fruit by-products powders.

The moisture, protein and fat content of chicken patties decreased significantly (P<0.05) with incorporation of beet root extract powder at higher level, but there was no significant difference between C and BE1 as well as BE2 and BE3. Significant decrease in all three values might be due addition of beetroot extract in dried form with less protein and fat content (Mirmiran et al. 2020) as presented in table 2. Present findings are in agreement with observations of Kumar et al. (2013) and Jin et al. (2014) reported for broccoli powder treated emu nuggets and red beet root power treated pork sausage respectively. Ash content increased significantly (P<0.05) with increased level of beet root extract powder incorporation in chicken patties. Higher ash content in treatment patties is oblivious, as beet roots are a good source of minerals (Babarykin et al. 2019). Similar trend for moisture and ash content was observed by Sahni and Shere (2016) for beet root pomace powder incorporated cookies.

Sensory attribute

Sensory scores for all sensory attributes increased significantly upto (P<0.05) BE2, except juiciness, thereafter the scores were decreased in BE3 chicken patties. Increase in color and appearance score occurs as light color of chicken patties conquered with incorporation of beet root extract powder at certain levels and offers a consumer appealing pink color to chicken meat products. Sucu and Turt (2018) also reported statistically significant increased color scores for beetroot powder incorporated fermented sausage. However, Sahni and Shere (2016) observed darker color in cookies on incorporation of beet root pomace powder at higher level. Elif Aykin-Dincer et al. (2020) also noted lower flavour score at higher level of incorporation of beetroot extract and powder in sausages. There was no significant difference for texture and juiciness scores between control and treatment patties. Higher overall acceptability of BE2 patties may be due to development of pleasant color and flavour in the product reflecting positive perception sensory panellists. Similar findings were recorded by Parkash et al. (2016) for apple pomace treated meat rolls.

Minced meat, salt and STPP
↓
Chopping for 30 sec (Bowl chopper)
↓
Addition of ice flakes
↓
Chopping for 1 min.
↓
Addition of vegetable oil
↓
Chopping for 1.5 min.
↓
Addition of binders
↓
Chopping for 2 min.
↓
Addition of refined wheat flour, spice mix and condiments (Garlic: ginger - 2:1)
↓
Chopping for 1.5 min
↓
Addition of onion/beetroot extract powder
↓
Chopping for 1.5 min
↓
Emulsion
↓
Moulding
↓
Cooking
↓
Chicken patties
↓
Packaging and Storage (4±1^{0}C)

Fig. 1: Preparation of chicken patties

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