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Original Research

Storage Stability of Optimized *Taraxacum officinale* (Dandelion) Extract Incorporated Chicken Meat Loaves under Refrigeration Storage (4±1◦C)

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Abstract

10% Taraxacum officinale extract (DLE) was optimized among 2.5% (T1), 5% (T2), 7.5% (T3), and 10% (T4) DLE levels for the development of functional chicken loaves based on the various quality parameters done in the preliminary trials. In this study, the T0 (control) and T4 (10% DLE) already optimized in the initial trials were incorporated in the chicken loaves packaged in LDPE pouches and stored at 4±1oC for 28 days. The samples were evaluated for various quality parameters during the storage. The pH and TBARS showed a significant increase while moisture and DPPH-RSA followed a significant decrease with the advancement of storage. The microbiological parameters showed a significant increase up to day 28. Although, the sensory scores decreased with the storage period for all attributes they remained acceptable for up to 21 days. Thus, it was concluded that DLE can be efficiently incorporated into chicken meat to develop functional chicken meat loaves without having any adverse effects during aerobic refrigeration.

Keywords: Dandelion, DLE, DPPH-RSA, *Taraxacum officinale*, TBARS .

Introduction

Meat is highly nutritious as it is composed of a complex substrate comprising of proteins, fats, carbohydrates, vitamins and minerals. It is also the source of various essential amino-acids and fatty-acids which are only confined to meat (Kamboh and Zhu, 2013). The substrate however, is prone to spoilage as well, as it forms a suitable matrix for the micro-organisms to proliferate leading to various defects in the meat products such as off odours, off flavours, discoloration, gas production and slime production. Therefore, the assurance of inventory and the shelf life of meat and meat products represent an important challenge for the meat industry**.**

Earlier, food was preserved by using salt, sugar, spices and wood smoke. With the development of new products, chemical antimicrobial agents and many organic acids were relied on to achieve a longer shelf life and greater assurance of protection from microbial spoilage. However, with growing concern over the presence of chemical residues in foods the demand for non-toxic natural preservatives is increasing which has paved the way for various natural anti-oxidants (Faine *et al*., 2006). *Taraxacum officinale*, commonly called Dandelion, is a herbaceous perennial plant of the family *Asteraceae* which belongs to the category of natural anti-oxidants. It possesses anti-inflammatory, anti-oxidative, anti-carcinogenic, analgesic, anti-hyperglycemic, anti-coagulatory and prebiotic effects (Sheikh *et al.,* 2015). Extracts of *Taraxacum officinale* are reported to contain adequate functional ingredients required to bring about the desired effect in the product eventually passed on to consumer and once proven to be effective can be suitably concentrated in order to use it in lower volume subsequently.

The current study was thus, conducted to evaluate the effect of *Taraxacum officinale* (Dandelion) extract incorporation in the chicken meat loaves to enhance their storage stability.

Materials and Methods

The study was conducted in the Division of LPT, FVSc & AH, SKUAST-K. Live chicken were procured from local market. After proper rest and ante-mortem examination, they were slaughtered in the Experimental Slaughter Hall by Halal method. The dressed chicken was deboned manually and chilled overnight before use. Fresh/sun-dried *Taraxacum officinale* (dandelion) leaves were procured from local market; ground to fine powder and then stored in containers for further use (Barimah *et al*., 2017). The vegetable oil, whole egg and salt were procured from the standard firms. Condiments were prepared by making a fine paste of onion, garlic and ginger in the ratio of 3:2:1. The spices purchased from reputed firms were ground and their powders were mixed in suitable proportion to obtain spice mixture. Low density polyethylene films (200µm gauge) used as the packaging material were also procured from reputed firms.

Preparation of Dandelion Leaf Extract

Ten g of dandelion leaf powder was mixed with 50 ml of boiled and cooled distilled water and the volume made up to 100 ml. This was left for 1 hour in a water bath (60ºC). The extract was filtered using a clean sterile muslin cloth and used at different concentrations (Qureshi, 2017).

Preparation of Chicken Meat Loaves

Lean meat obtained from chicken was minced in a mincer with 4 mm plate. Minced meat was loaded in the bowl chopper, wherein salt along with half of chilled water was added for better extraction of salt soluble proteins. The chopping was done for 2 minutes. After that vegetable oil was added and chopping continued for another 2 minutes. This was followed by addition of whole egg liquid, dry spice mix and condiment paste. The contents were again chopped for 1 minute to get the proper emulsion. This formulation served as control. Throughout the preparation, the optimized level (10%) of Dandelion Leaf Extract (DLE) was added by replacing chilled water from the basic formulation of the product. The emulsion prepared was then weighed and filled in stainless steel moulds. Moulds were covered with lid and cooked in hot water (90˚C) for 35 minutes to an internal temperature of around 80˚C. Chicken loaves so obtained were cooled to room temperature, packaged into low density polyethylene (LDPE) bags (200 µm gauge) and analyzed for different quality parameters at regular intervals.

The formulation of control and treated chicken meat loaves is given in Table 1.

Table 1: Formulation of control and treated chicken loaves

Ingredients	Percentage (w/w) Control loaves (T_0)	Percentage (w/w) DLE loaves (T_4)
Lean meat	78.0	78.0
DLE	0	10
Ice/Chilled water	10	0
Vegetable oil	5.0	5.0
Condiment paste	3.0	3.0
Whole egg	2.0	2.0
Salt	1.0	1.0
Dry spice mix	1.0	1.0
TOTAL	**100**	**100**

Analytical Procedures

The pH of chicken meat loaves was determined by the method of Trout *et al.* (1992) using digital pH meter. The moisture content was evaluated as per standard procedure of AOAC (2005). The DPPH- RSA (%) assay was done according to the method of Brand-Williams *et al.*, 1995 with some modifications. The estimation of TBARS value was done by the method of Witte *et al.*, 1970. The samples of meat products were subjected to microbiological analysis for Total Plate Count, Coliform Count and Yeast and Mould Count as per the method described by APHA (2015).

Sensory Evaluation

Sensory evaluation of the products was done by the scientists of the division of LPT. The organoleptic attributes namely general appearance, flavour, binding, texture, saltiness, juiciness and overall acceptability were evaluated using an 8-point descriptive scale, where 8=extremely desirable and 1=extremely undesirable for any attribute (Keeton, 1983).

Statistical Analysis

The data generated was analyzed statistically following the method of Snedecor and Cochran (1994) using the SPSS version 20 software package. Analysis of variance was computed and the significance of means was tested at 5% level. The results as Mean±S.E were compared for significance and interpretations were made accordingly.

Results and Discussion

Physico-chemical Properties

The mean values for various physico-chemical properties of dandelion leaf extract incorporated chicken meat loaves are presented in Table 2, Fig 1 and Fig 2.

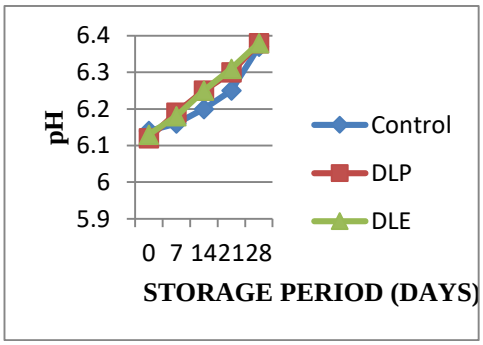


Fig 1: Change in pH value during storage

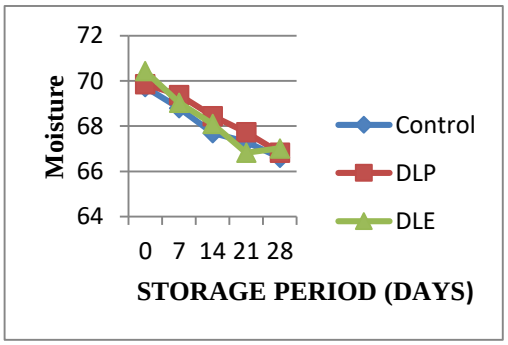


Fig 2: Change in moisture value during storage

Table 2: Effect of storage period and Dandelion Leaf Extract (DLE) on pH and Moisture value of chicken meat loaves during refrigerated storage (4±1°C)

Treatment	Storage period (days)					Treatment Mean ± SE
	0	7	14	21	28	
pH						
Control	6.14±0.00^{cA}	6.16±0.00^{aB}	6.20±0.01^{aC}	6.25±0.00^{aD}	6.37±0.01^{aE}	**6.22±0.02^{a}**
DLE	6.13±0.00^{bA}	6.18±0.00^{bB}	6.25±0.00^{bC}	6.31±0.01^{bD}	6.38±0.00^{aE}	**6.25±0.02^{a}**
Moisture (%)						
Control	69.73±0.71^{aC}	68.80±0.50^{aBC}	67.70±0.39^{aAB}	67.30±0.36^{aA}	66.61±0.37^{aA}	**68.03±0.29^{a}**
DLE	70.44±0.22^{aD}	69.04±0.09^{aC}	68.10±0.30^{aB}	66.83±0.20^{aA}	67.02±0.26^{aA}	**68.29±0.27^{a}**
TBARS (mg malonaldehyde/kg)						
Control	0.27±0.01^{cA}	0.34 ±0.01^{bB}	0.41±0.00^{cC}	0.52±0.01^{cD}	0.65±0.01^{cE}	**0.44± 0.03^{b}**
DLE	0.22 ±0.01^{aA}	0.27 ±0.00^{aB}	0.30±0.01^{aC}	0.37±0.00^{aD}	0.45±0.00^{aE}	**0.32± 0.02^{a}**
DPPH- RSA (%)						
Control	41.41±0.31^{aE}	36.91±0.91^{aD}	30.30±1.36^{aC}	23.92±1.11^{aB}	12.79±0.76^{aA}	**29.07±1.91^{a}**
DLE	71.68±0.35^{cE}	66.52±0.70^{cD}	61.85±1.17^{bC}	56.09±1.74^{bB}	51.26±2.50^{cA}	**61.48±1.48^{b}**

*Mean ± SE with different small letters column-wise and capital letters row-wise as superscripts differ significantly (P<0.05); * N =6*

With the advancement of storage period, significant (P≤0.05) increase in the mean pH values of control and treated loaves was observed. Increase in pH of products during storage could be due to production of basic amines from protein breakdown by micro-organisms. Bhat *et al*. (2013) observed similar findings of pH in chicken seekh kababs in aerobic refrigeration storage.

During storage, an overall decrease in moisture was observed in control and treated chicken meat loaves. This moisture loss might be attributed to loss of drip fluid and evaporation of moisture from chicken loaves during storage. Bargaje (2009) observed that the reduction in moisture content might be due to utilization of the moisture by microorganism during storage of meat product. The results were in agreement with Reddy and Mallika (2004) who reported similar pattern of moisture content in duck meat nuggets on storage.

The mean TBARS values of control and dandelion leaf extract incorporated chicken meat loaves increased significantly (P≤0.05) during storage period. However, the increase was significantly (P≤0.05) higher in control compared to that of the treated loaf. This increase in TBARS values with storage period might be due to the lipid oxidation and the production of volatile metabolites in the presence of oxygen owing to oxygen permeability of packaging material (Brewer *et al*., 1992). The significantly lower (P≤0.05) TBARS values for treated loaves could be due to the presence of phenolic compounds in dandelion leaf extract. These phenolic compounds are mainly involved in the retardation of lipid oxidation because they could inhibit free radical formation and the propagation of free radical reactions (Kumar *et al*. 2015). Similar findings were reported by Qureshi (2017) in fenugreek seed extract incorporated functional spent hen meat patties.

The mean DPPH-RSA (%) values of control and treated chicken meat loaves decreased significantly (P≤0.05) during storage period. The significantly (P≤0.05) higher DPPH-RSA (%) value in treated chicken meat loaves might be due to the addition of antioxidant rich Dandelion Leaf Extract, being rich sources of phenolic compounds. Our results were also in agreement with Rovida (2016) and Qureshi (2017) who found similar trend in mutton nuggets incorporated with walnut kernel paste and chicken patties incorporated with fenugreek seed extract, respectively.

Microbiological Parameters

The mean values for various microbiological counts of dandelion leaf extract incorporated chicken meat loaves are presented in Table 3.

Table 3: Microbiological counts (Total Plate Count, Coliform Count and Yeast and Mould Count) of functional chicken meat loaves incorporated with Dandelion Leaf Extract (DLE) during refrigerated (4±1°C) storage (Mean ± S.E)

Treatment	Storage period (days)					Treatment mean ± SE
	0	7	14	21	28	
Total Plate Count (log cfu/g)						
Control	0.90±0.01^{cA}	2.07±0.01^{cB}	2.92±0.00^{cC}	3.56±0.01^{cD}	4.26±0.01^{cE}	**2.74±0.22^{a}**
DLE	0.79±0.00^{aA}	1.91±0.00^{aB}	2.50±0.01^{aC}	3.10±0.02^{aD}	3.65±0.04^{aE}	**2.39±0.18^{a}**
Coliform count (log cfu/g)						
Control	-	-	0.25±0.01^{bA}	0.76±0.00^{cB}	1.27±0.00^{cC}	**0.46±0.09^{a}**
DLE	-	-	0.23±0.00^{aA}	0.68±0.00^{aB}	1.13±0.01^{aC}	**0.41±0.08^{a}**
Yeast and Mound Count (log cfu/g)						
Control	-	-	-	0.64±0.01^{cA}	1.17±0.00^{cB}	**0.36 ± 0.09^{a}**
DLE	-	-	-	0.42±0.01^{aA}	0.87±0.00^{aA}	**0.26 ± 0.06^{a}**

Mean ± SE with different small letters column-wise and capital letters row-wise as superscripts differ significantly (P<0.05) N =6; - (Not Detected)*

During storage, an overall increase in Total Plate Count was observed in all chicken meat loaves. The mean TPC of control and treated chicken meat loaves increased significantly (P≤0.05) up to 28th day of storage. The increased TPC could be due to the excellent growth medium available to the bacteria in the form of chicken loaves. The results are in agreement with Hegazy (2011) who reported that the total plate count increased with the advancement in the storage time. During storage, coliform counts were not detected during initial period of storage up to 7th day in control as well as treated chicken meat loaves. Mean coliform count of control and treated chicken loaves increased significantly (P≤0.05) from 14th to 28th day of storage. The decreased rate of increase in the number of bacteria in treated loaves could be attributed to anti-microbial effect of dandelion leaf extract. Good hygienic practices implemented during handling, processing, packaging and analysis of products could be one of the reasons for the absence of coliforms during initial phases of storage. Similar trend in coliform gowth was reported by Qureshi (2017) in spent hen meat patties incorporated with fenugreek seed extract. Yeast and mould count of the DLE incorporated chicken meat loaves was lower than control but the difference was non-significant (P≥0.05). The anti-microbial effect associated with the dandelion leaf extract could be responsible for the slower increasing rate of yeast and mould count in the DLE incorporated loaves. YMC were not detected during early period of storage study till 21st day which could be due to thorough cooking, good hygiene and absence of post processing contamination. Similar results were reported by Das *et al.* (2013) during aerobic storage of chicken nuggets.

Sensory Attributes

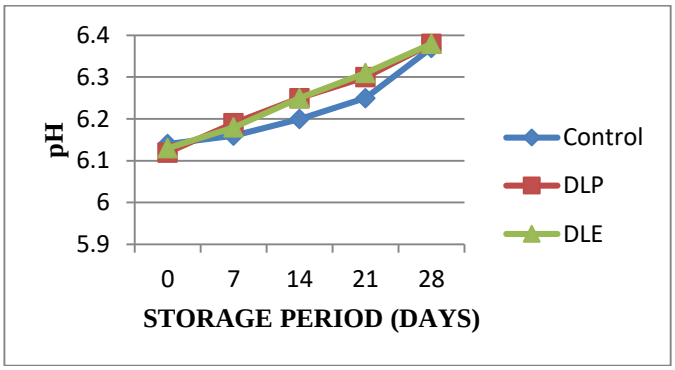
The mean values for various sensory attributes of dandelion leaf extract incorporated chicken meat loaves are presented in Table 4.

Table 4: Sensory attributes of functional chicken meat loaves incorporated with Dandelion Leaf Extract (DLE) during refrigerated (4±1°C) storage (Mean± S.E)

Treatment	Storage period (days)					Treatment mean ± SE
	0	7	14	21	28	
Appearance						
Control	7.43±0.11^{bE}	7.00±0.12^{aD}	6.43±0.11^{aC}	5.86±0.14^{aB}	4.71±0.10^{aA}	**6.29±0.11^{a}**
DLE	7.86±0.08^{cD}	7.57 ± 0.11^{bD}	7.00±0.17^{bC}	6.57 ±0.16^{bB}	5.67±0.11^{cA}	**6.93±0.09^{b}**
Flavour						
Control	7.43±0.11^{aD}	7.14±0.14^{aD}	6.57±0.11^{aC}	6.14±0.14^{aB}	4.43±0.11^{aA}	**6.34±0.12^{a}**
DLE	8.00±0.00^{cD}	7.86± 0.08^{bCD}	7.71± 0.10^{bBC}	7.57±0.11^{bB}	5.81±0.09^{cA}	**7.39±0.09^{c}**
Texture						
Control	7.57±0.11^{aD}	7.29±0.16^{aD}	6.86±0.08^{aC}	6.29±0.10^{aB}	5.14±0.08^{aA}	**6.63±0.10^{a}**
DLE	7.85±0.08^{aC}	7.71±0.10^{bC}	7.57±0.11^{cC}	7.29±0.10^{cB}	6.43±0.11^{bA}	**7.37±0.07^{c}**

			Juiciness			
Control	7.71±0.10^{aD}	7.57±0.11^{aD}	6.57±0.11^{aC}	5.86±0.08^{aB}	4.52±0.11^{aA}	**6.45±0.12^{a}**
DLE	7.86±0.08^{aD}	7.71±0.10^{aD}	7.29±0.10^{bC}	6.86±0.14^{cB}	5.81±0.09^{cA}	**7.10±0.09^{b}**
			Saltiness			
Control	7.86±0.08^{abC}	7.86±0.08^{abC}	7.71±0.10^{aC}	7.43±0.11^{aB}	7.00±0.00^{aA}	**7.57±0.05^{a}**
DLE	8.00±0.00^{bB}	8.00 ±0.00^{bB}	8.00±0.00^{bB}	8.00±0.00^{bB}	7.86±0.08^{cA}	**7.97±0.02^{b}**
Mouth coating						
Control	8.00±0.00^{C}	8.00±0.00^{C}	7.71±0.10^{bB}	7.57±0.11^{bB}	7.29±0.10^{bA}	**7.71±0.04^{b}**
DLE	7.00±0.00^{C}	7.00±0.00^{C}	6.86±0.08^{aBC}	6.71±0.10^{aAB}	6.57±0.11^{aA}	**6.83±0.04^{a}**
Overall acceptability						
Control	7.57±0.11^{aE}	7.00±0.12^{aD}	6.29±0.10^{aC}	5.33±0.11^{aB}	4.24±0.10^{aA}	**6.09±0.13^{a}**
DLE	7.86±0.08^{aD}	7.71±0.10^{bD}	7.14±0.14^{bC}	6.33±0.11^{bB}	5.43±0.11^{cA}	**6.90±0.10^{b}**

Mean ± SE with different small letters column-wise and capital letters row-wise as superscripts differ significantly (P<0.05)
** N =21, * 8-point descriptive scale (8 = extremely desirable, 1 = extremely undesirable)*



The sensory attributes were significantly affected during 28 days of refrigerated storage and all the sensory parameters followed a descending trend (P≤0.05) with storage. Mean scores for treated loaves were comparable (P≤0.05) to control loaves throughout the storage period for all sensory parameters. The decrease in appearance scores could be due to surface dehydration in aerobic packaging and some pigment and lipid oxidation resulting in metmyoglobin accumulation and non-enzymatic browning. A gradual decline in flavor might be due to the expected loss of volatile flavor components from spices and condiments on storage of meat products. Decline in texture scores could be due to surface dehydration leading to hardening of product; protein oxidation and microbial action on proteins leading to proteolytic and disulphide bond changes with progress of storage period. The decreasing trend in juiciness scores throughout the storage period could be because of some loss of moisture from the products. The overall acceptability scores of both control and treated loaves decreased as the storage progressed. This decrease might be reflective of the decline in scores of appearance, flavour, texture, juiciness and saltiness. Similar observations for all the sensory attributes were reported by Singh *et al*. (2011) in chicken snacks.

Conclusion

The aerobic refrigerated (4±1°C) storage of the *Taraxacum officinale* (dandelion) extract incorporated chicken meat loaves in LDPE pouches kept the products fairly acceptable up to 21 days without any compromise in the quality of the product. Dandelion leaf extract **(**DLE) proved to be an efficient source of antioxidants because with their incorporation, DPPH-RSA of the product was significantly increased and TBARS value significantly decreased. The microbial counts (Total Plate Count, coliform count and yeast and mould count) decreased significantly in functional chicken meat loaves reflecting their good microbial effect as well.

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Contribution by Authors

Each co-author contributes equally.

Conflict of Interests

There is no conflict of interest.

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