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Efficacy of dandelion (*Taraxacum officinale*) leaf powder for the development of functional chicken meat loaves

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Abstract
Locally available natural sources like dandelion (*Taraxacum officinale*), being rich source of functional ingredients can be exploited for their functional role by incorporating them in chicken meat loaves. Hence, a study was designed to evaluate the effect of incorporation of oven-dried Dandelion Leaf Powder (DLP) at three levels 1% (T1), 2% (T2) and 3% (T3) replacing lean meat in the formulation of the product. Cooking yield of chicken meat loaves showed a non-significant (P>0.05) increase with increase in levels of DLP. pH values increased non-significantly (P>0.05) among the treatment groups, with increase in levels of DLP. The percent moisture showed a non-significant (P>0.05) increase whereas the percent protein as well as fat content showed a non-significant (P>0.05) decrease among all the treatments including control. The percent ash content of 2% and 3% level was significantly (P≤0.05) higher than control whereas a non-significant (P>0.05) difference was found between control and 1% level. The antioxidant activity in terms of DPPH-RSA value showed a significant (P≤0.05) increase with increase in levels of Dandelion leaf powder and was higher at 3% DLP incorporation. Sensory evaluation of the products revealed a non-significant (P>0.05) difference in various attributes of control and all the other treatments. Thus, it was concluded that dandelion leaf powder up to 1% level can be efficiently incorporated in chicken meat loaves for improving their functional value.

Keywords: Dandelion, DLPICML, DPPH-RSA, functional, loaves

1. Introduction
In today's increasingly rapid world, this fast-paced lifestyle and the improved socio-economic conditions have made people addicted to food and eatables that can be readily made increasing the demand for ready-to-eat meat products. People find it convenient to eat such food items which please the taste buds more than the regular foods, thus paving the way for various lifestyle diseases. Therefore, there is a growing consumer demand for high quality functional food products. Also, consumer preference for natural ingredients over synthetic ones have opened new avenues for the meat industry around the world for development of functional products with natural and safe non-meat ingredients including antioxidants.
Hence, functional foods which are manufactured by restructuring the conventional foods by adding various natural functional ingredients have come into existence. Plants of the genus *Taraxacum* have long been used as medicinal herbs. The first reference to its application is reflected in its name, which is derived from the Greek word "taraxis" for inflammation and "akeomai" for curative. Dandelion (*Taraxacum officinale*) possesses many health benefits as it is anti-hyperglycemic, anti-inflammatory, anti-diabetic, anti-microbial, hypolipedemic, immunostimulatory and anti-oxidative (Wringo *et al*., 2016)[1]. Keeping in view the above mentioned facts, the study was devised with the objective of exploring the feasibility of using oven-dried Dandelion Leaf Powder (DLP) on quality characteristics of chicken meat loaves.

2. Material and Methods
2.1. Preparation of oven-dried dandelion leaf powder (DLP)
Fresh/sun-dried dandelion (*Taraxacum officinale*) leaves were procured from the local market after which they were oven-dried at 60 ˚C for 3 hours. Oven-dried dandelion (*Taraxacum officinale*) leaves were ground to fine powder in an electric grinder and then stored in plastic containers for further use (Barimah *et al*., 2017) [2].

Fig 1: *Taraxacum officinale* (Scientific name) Dandelion (Common name) Haend (Local name in Kashmir) Family: Asteraceae (Compositae)

2.2. Preparation of chicken meat loaves

The study was conducted in the Division of Livestock Products Technology, Faculty of Veterinary Sciences and Animal Husbandry, SKUAST-Kashmir. Live chicken (broiler) were procured from the local market. After proper rest and ante-mortem examination, they were slaughtered in the Experimental Slaughter Hall of the Division of Livestock Products Technology by Halal method. The dressed chicken were deboned manually and chilled overnight before use or were stored in frozen condition until used. Lean meat obtained from broiler chicken was minced in a mincer (MSW-627) with 4 mm plate. Meat emulsion for broiler chicken meat loaves was prepared in Bowl Chopper (SCHARFEN, Germany). 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 gradually added and chopping continued for another 2 minutes. This was followed by addition of whole egg liquid, dry spice mix and condiment paste (onion: garlic: ginger = 3:2:1). The contents were again chopped for 1 minute to get the proper emulsion. This formulation served as control. Throughout the preparation, the Dandelion Leaf Powder (DLP) at different levels 1%, 2%, 3% was added by replacing lean meat 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 tied with thread and cooked in hot water (90 $^{\circ}$C) for 35 minutes to an internal temperature of around 80 $^{\circ}$C. The internal temperature of loaves was monitored by a thermometer. All the three treatments of chicken meat loaves *viz*., T_1, T_2 and T_3 having 1, 2 and 3 percent DLP along with control (T_0) were assessed for various parameters *viz*., cooking yield (%), pH, moisture (%), protein (%), fat (%), ash (%), DPPH-RSA and sensory characteristics. The optimum level of DLP (1%) was selected on the basis of overall quality of the product. The experiment was repeated thrice.

Table 1: Basic formulation of loaves

Ingredients	Quantity (w/w) per 100 g for T_0 (control)	
Lean meat	78.0	Dandelion Leaf Powder (DLP) at different levels viz. 1% (T_1), 2% (T_2) and 3% (T_3) was added by replacing lean meat from the basic formulation
Chilled water	10.0	
Vegetable oil	5.0	
Condiment paste	3.0	
Whole egg	2.0	
Salt	1.0	
Dry spice mix	1.0	

3. Methods of Estimation

3.1. Cooking yield: The weight of chicken meat loaves was recorded before and after cooking and the yield was calculated as;

$$\text{Cooking yield (\%)} = \frac{\text{Weight of cooked loaves}}{\text{Weight of uncooked emulsion}} \times 100$$

3.2. pH

The pH of chicken meat loaves was determined by the method of (Trout *et al*., 1992) [3] by using digital pH meter (Model EE-011, Tanco Laboratory Equipments Ltd. India).

3.3. Proximate composition

The percentage moisture, protein, ether extract and ash content of the product samples were evaluated as per standard procedure of Association of Official Analytical Chemists (AOAC, 2005) [4].

3.4. DPPH assay

The DPPH assay was done according to the method of (Brand-Williams *et al*., 1995) [5] with some modifications. The stock solution of DPPH was prepared by dissolving 24 mg of DPPH dissolved with 100 ml methanol and then stored at -20 ^{0}C until needed. The working solution was obtained by mixing 10 ml stock solution with 80 ml methanol to obtain an absorbance of 1.1±0.02 units at 515 nm using the spectrophotometer. 150 µl of meat extract was allowed to react with 2850 µl of the DPPH solution for 24 h in the dark. Then, the absorbance was taken at 515 nm. The radical scavenging activity was measured using the formula:

$$\text{Radical scavenging percentage (\%)} = \frac{\text{Blank absorbance} - \text{Sample absorbance}}{\text{Blank absorbance}} \times 100$$

3.5. Sensory evaluation

Samples of products from all treatments were presented to the semi-trained experienced taste panel members consisting of scientists and post-graduate students of Faculty of Veterinary Sciences and Animal Husbandry, Shuhama, SKUAST-K for evaluation of various sensory parameters viz., appearance, flavour, texture, juiciness, saltiness, mouth coating, and overall acceptability as per 8-point descriptive scale (Keeton, 1984) [6], where 8 is extremely desirable and 1 is extremely undesirable. The samples were suitably warmed before serving to the panelists.

3.6. Statistical Analysis
The statistically analyzed results have been interpreted and tabulated. The results were analyzed and tabulated statistically by ANOVA using SPSS software (IBM SPSS statistics – Version 20). The results were expressed as Mean ± S.E at 5% level of significance (Snedecor and Cochran, 1994) [7].

4. Results and Discussion
4.1. Cooking yield and pH
There was a non-significant (P>0.05) increase in the cooking yield with the increase in the levels of DLP. The increase in cooking yield with DLP addition can be attributed to improvement of the hydration and binding properties of the product. The results were in agreement with (Turhan and Sagir, 2005) [8] who reported better cooking yield of beef burgers upon the addition of hazelnut pellicle. Talukder *et al*. (2014) [9] found better cooking yield of restructured chicken meat block incorporated with the increasing levels of lotus root powder. Reshi (2016) [10] found that cooking yield of spent hen meat sausages increased with the increase in incorporation of lotus stem powder. The pH value of control was significantly (P≤0.05) lower than 2% and 3%, and non-significantly (P>0.05) lower than 1% Dandelion Leaf Powder Incorporated Chicken Meat Loaves (DLPICML). Among the treatment groups, pH values increased non-significantly (P>0.05) with increase in levels of DLP. The slight increase in the pH values by the addition of Dandelion Leaf Powder might be attributed to somewhat higher pH (around 6.5) of the dandelion leaves as compared to the raw lean meat (around 5-6). The results were in agreement with Qureshi *et al.* (2018) [11] who reported that the addition of fenugreek seed powder and its extract to spent hen meat patties caused slight but not significant increase in the pH values of chicken patties.

Table 2: Physico-chemical properties of chicken meat loaves containing various levels of oven-dried Dandelion Leaf Powder (Mean±S.E)

Parameters		Oven-dried Dandelion Leaf Powder		
	Control	1%	2%	3%
Product pH	6.16±0.03^{a}	6.23±0.03^{ab}	6.26±0.03^{b}	6.29±0.03^{b}
Cooking yield (%)	84.91±1.65	85.86±1.33	86.83±1.89	87.95±1.76

Row-wise group means with different superscripts differ significantly (P<0.05) For CY, N=3 and for pH, N=6.

4.2. Proximate Composition
Moisture content of all the chicken meat loaves incorporated with Dandelion leaf powder showed a non-significant (P>0.05) increase when compared to control. Moisture percentage showed an increasing trend with the increasing DLP levels in comparison to control products, which might be due to increasing water retention with the increase in level of the Dandelion leaf powder. Talukder *et al*. (2014) [9] found improved moisture content of chicken meat blocks with the increase in the level lotus root powder. Qureshi *et al.* (2018) [11] reported a non-significant increase in the moisture content of spent hen meat patties with increasing incorporation of fenugreek seed powder. Protein content of all the chicken meat loaves incorporated with Dandelion leaf powder showed a non-significant (P>0.05) decrease when compared to control. The decreasing trend in the protein content of the product could be attributed to a slightly lower protein content of dandelion leaves as compared to the lean meat (replaced in place for DLP in the product formulation). Talukder *et al*. (2014) [9] found decreased protein content of chicken meat blocks with the increase in the levels of lotus root powder. Rovida *et al*. (2018) [12] also reported decrease in the protein content of mutton nuggets incorporated with increasing levels of walnut kernel paste and saffron petal powder. Fat content of all the chicken meat loaves incorporated with Dandelion leaf powder showed a non-significant (P>0.05) decrease when compared to control. The lower fat content of DLP could be the reason for the decrease in fat content of DLPICML. Talukder *et al*. (2014) [9] found decreased fat content of chicken meat blocks with the increase in the levels of lotus root powder. The ash content improved only slightly up to 1% DLP addition. The difference was significant (P≤0.05) at 2% and 3% incorporation levels. The increasing trend of ash content with increase in the level of Dandelion leaf powder may be due to high levels of ash content of the dandelion leaves as also supported by Qureshi *et al*. (2016) [13]. The results were also in agreement with the findings of Kumari *et al.* (2015) [14] who reported that the ash content of chicken patties showed a significantly (P≤0.05) increasing trend with the increase in the level of Lungru (*Diplazium esculentum*). Qureshi *et al.* (2018) [11] reported an increase in the ash content of spent hen meat patties incorporated with the increasing levels of fenugreek seed powder.

Table 3: Proximate composition of chicken meat loaves containing various levels of oven-dried Dandelion Leaf Powder (Mean ± S.E)

Parameters		Oven-dried Dandelion Leaf Powder		
	Control	1%	2%	3%
Moisture (%)	69.89±0.70	70.06±0.34	70.44±0.22	70.47±0.31
Protein (%)	17.59±0.38	17.36±0.30	17.23±0.13	17.07±0.22
Fat (%)	6.62±0.06	6.60±0.04	6.58±0.03	6.56±0.02
Ash (%)	0.88±0.16^{a}	1.32±0.06^{ab}	1.74±0.07^{bc}	1.78±0.24^{c}

Row-wise group means with different superscripts differ significantly (P<0.05) *N = 6

4.3. Radical Scavenging Activity
There was an increase in the DPPH-RSA values with increase in the levels of Dandelion Leaf Powder and a significant (P≤0.05) increase was found at all levels from 1% DLP incorporation. The increase in the values with increasing levels of Dandelion Leaf Powder might be attributed to the better antioxidant potential of phenolic rich dandelion leaves. Sheikh *et al*. (2015) [15] conducted a study on the *in vitro* antioxidant activity, total phenolic and total flavanoid contents of *Taraxacum officinale* leaves and reported a huge antioxidant potential of the plant. Barimah *et al*. (2017) [2] also concluded about the tremendous antioxidant potential of *Taraxacum officinale* leaves.

Table 4: Antioxidant activity of chicken meat loaves containing various levels of oven-dried Dandelion Leaf Powder (Mean ± S.E)

Parameter		Oven-dried Dandelion Leaf Powder		
	Control	1%	2%	3%
DPPH-RSA	40.95±0.41^{a}	50.37±0.27^{b}	55.32±0.35^{c}	60.66±0.44^{d}

Row-wise group means with different superscripts differ significantly (P<0.05) * N = 6

4.4. Sensory Evaluation
Organoleptic evaluation of the products revealed no significant differences in the various attributes between the

control and DLPICML. All of the sensory attributes showed a declining trend with increasing DLP incorporation, 1% DLPICML being non-significantly (P>0.05) higher than control for all attributes, except for appearance which was non-significantly (P>0.05) lower than control. Hegazy (2011) [16] concluded that there was no significant difference in color, taste, flavor and appearance scores of beef burger samples with 3 and 6% Fenugreek Seed Flour (FSF) incorporation. Rovida *et al*. (2016) [12] reported organoleptic evaluation of the mutton nuggets revealed no significant differences in the various sensory attributes between the control and walnut kernel added nuggets.

Table 5: Sensory attributes of chicken meat loaves containing various levels of oven-dried Dandelion Leaf Powder (Mean±S.E)

Sensory attributes		Oven-dried Dandelion Leaf Powder		
	Control	1%	2%	3%
Appearance	7.95±0.11^{c}	7.90±0.07^{c}	6.86±0.14^{b}	6.29±0.21^{a}
Flavour	7.24±0.19^{c}	7.33±0.13^{c}	6.48±0.18^{b}	5.90±0.18^{a}
Texture	7.10 ±0.23	7.67 ±0.14	7.19 ±0.20	7.10±0.21
Juiciness	6.95±0.05^{bc}	7.19 ±0.11^{c}	6.67±0.11^{ab}	6.43±0.18^{a}
Saltiness	7.24±0.12^{ab}	7.43±0.15^{b}	6.90±0.21^{ab}	6.76±0.26^{a}
Mouth-coating	7.10±0.17	7.29±0.14	6.71±0.27	6.67±0.28
Overall acceptability	7.38±0.16^{b}	7.67±0.14^{b}	6.71±0.10^{a}	6.43±0.15^{a}

Row-wise group means with different superscript differ significantly (P<0.05)
*8-point descriptive scale (8 = extremely desirable, 1 = extremely undesirable)**N= 21

5. Conclusion
Functional chicken meat loaves can be effectively prepared by the addition of *Taraxacum officinale* (dandelion) powder without any adverse effects. Morever, the addition of *Taraxacum officinale* in the chicken meat loaves improves the overall nutritive, sensory and anti-oxidative properties of the functional chicken meat loaves.

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