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Research paper

Effect of Oatmeal as Fat Replacer on the Quality of Low Fat *Goshtaba* Prepared by Traditional and Machine Methods

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ABSTRACT

The effects of traditional and machine methods of preparation on the quality and acceptability of low-fat *Goshtaba* formulated with 10% hydrated oatmeal as fat replacer was studied by evaluating them for physicochemical and sensory quality. To achieve this objective, the raw emulsions were prepared by traditional (T) and machine (M) method following the standardized processing protocols and formulations served as controls (T_0 and M_0) and were modified only to the extent of addition of the 10% hydrated oatmeal as fat replacer and served as treatments (T_1 and M_1). The results showed that the pH of T_1 *Goshtaba* was higher (P<0.05) than that of T_0 whereas pH of M_0 and M_1 were similar. The emulsion stability of T_1 and M_1 was better (P<0.05) and that of T_1 was better than M_1 (P<0.05). The percent cooking yield of T_1 and M_1 was relatively higher (P>0.05) than that of the controls. The yield of T_1 was higher (P<0.05) than M_1. The percent moisture of T_1 emulsion was higher (P<0.05) than that of T_0. The percent moisture of T_1 *Goshtaba* was higher (P<0.05) than that of its control. The percent protein of *Goshtaba* was higher (P<0.05) under the traditional method. The percent fat of T_1 and M_1 was higher (P<0.05). The percent ash of T_1 *Goshtaba* was higher (P<0.05) than that of M_1. The sensory scores for appearance were similar as also were the scores for flavour as well as juiciness. The trend of these sensory scores was T_1>T_0>M_1>M_0. The trend of scores for overall palatability was similar to that of texture *viz.*, T_1>M_1>T_0>M_0. These results demonstrated better performance of traditional method of preparation of low fat *Goshtaba* formulated with 10% hydrated oatmeal.

Keywords: *Emulsion, Fat, Goshtaba, Machine, Replacer, Traditional, Wazwan.*

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INTRODUCTION

Goshtaba is a fat-rich emulsion-based meat product prepared traditionally by pounding meat along with fat on a smooth-surfaced stone, followed by moulding emulsion in the form of a spherical ball and finally cooking in gravy based on curd (Jalal et 2014). A considerable amount of animal fat (20%) is used in the formulation to achieve a stable emulsion, and also to impart special organoleptic quality to the product (Hussain et al. 2015). Fat plays a vital role in optimizing sensory properties by binding with the heat-induced gel of salt extractable proteins in comminuted meat products. However, dietary fat has been implicated in the development of cardiovascular diseases, hypertension, and obesity (Wylie and Judith 2002). Low-fat meat products are in great demand as they have been perceived as more healthy by consumers. However, there are many problems concerning the acceptance of these products, for example when fat levels are lowered the products become firmer, more rubbery, less juicy, darker in colour, costly, and less acceptable in terms of palatability. Hence manufacturers have introduced several modifications in an attempt to offset the detrimental effects of fat reduction. They include the use of non-meat ingredients to improve the texture and the water holding capacity and/or the adaptation of procedures to modify the composition of final products (Das and Mandal 2014). Oat and oat constituents have received increased consideration for use in low-fat products due to their functional and nutritional qualities (Yilmaz and Daghoglu 2003). Oatmeal is one of the most effective ingredients in cooked low-fat meat products with the ability to mimic fat characteristics. This ingredient can be used to offset the poor quality associated with low-fat beef burgers (Troy et al. 1999).

Goshtaba, the traditional meat product of Ja[1]mmu and Kashmir, India, which is famous throughout the world, contains high proportions of animal fat. Most of the operations involved in the preparation of *Goshtaba* are performed manually. Mechanised production of heritage/ethnic restructured meat products (*Goshtaba*) is an essential criterion to meet the increasing market demands for traditional meat products. Thus there is a great scope and need for improvements over the traditional practices followed in its formulation and preparation to enhance its quality, safeguard the health of consumers and thereby improve consumer appeal and demand for these traditional products. Thus, the objective of this study was to evaluate the effect of oatmeal as a fat replacer and machine intervention on the quality attributes of *Goshtaba,* a traditional meat product of J&K, India.

MATERIALS AND METHODS

Lean mutton and fat were obtained from the local market from young and tender male lambs in the age group of 6-9 months, within 2 hours of slaughter. All subcutaneous fat and visible connective tissues were removed. The meat was initially analyzed for fat content prior to the manufacture of the emulsion. Non-meat ingredients, salt, curd from cow's milk, oil, and spices such as garlic, onion, cardamom, cinnamon, cloves, and ginger powder, were procured from the local market. The oatmeal used in this study was procured from the local market. The Experiment was planned wherein the product emulsion was prepared by employing the traditional method as well as a Bowl Chopper. Based on the result of preliminary trials, oatmeal @10% was used as a fat replacer in this experiment along with the control.

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The product was prepared according to the standardized processing schedules of Jalal et al. 2014). The raw emulsion prepared by the traditional method was divided into two equal parts. One part served as T0 (control) and was used as such. To another part, oatmeal was added @10% and served as T1. Similarly, the raw emulsion prepared by the machine method was divided into two equal parts. One part served as M0 (control) and was used as such. To another part, oatmeal was added @10% and served as M1. The quality of the raw emulsion, the fresh meat products, and the respective gravies were evaluated in terms of various parameters, viz., pH, cooking yield, emulsion stability, proximate composition, and sensory characteristics. The experiment was repeated thrice.

Samples were subjected to quality evaluation in terms of physico-chemical and sensory attributes. Moisture, protein, fat, and ash contents of raw emulsion, cooked product, and gravy were estimated as per AOAC (1995). The pH and emulsion stability of the raw samples was determined as per Keller et al. (1974) and Baliga and Madaiah (1970), respectively. The cooking yield percent was calculated by dividing the weight of cooked balls by the weight of respective uncooked balls. Sensory quality was evaluated as per Seman et al. (1987) wherein the product chunks in their respective gravies were served hot to a group of not less than 8 experienced panel of judges. The product samples were assessed under incandescent light for their appearance, flavour, juiciness, texture, and overall palatability as per the score card of Anjaneyulu (1988) based on an 8-point descriptive scale. Water was provided between samples to cleanse the palate. The data obtained from three replications were analyzed by analysis of variance, Duncan's multiple range test and critical difference were determined at a 5% significance level using SPSS-version 20.0.

RESULTS AND DISCUSSION

The pH values of control (T_0) and 10% hydrated oatmeal formulated raw emulsions prepared by the traditional method were significantly higher ($P<0.05$) than those of control (M_0) and hydrated oatmeal formulated emulsions prepared by machine (Table 1). Between the control and oatmeal formulated samples under each method of preparation, non-significant differences were observed in relation to pH. The pH values of oatmeal supplemented *Goshtaba* samples under the traditional method (T_1) was significantly higher ($p<0.05$) than that of its control (T_0). In general, the pH values were relatively lower in the cooked products. Samoon (1988) has reported that hot processed raw *Goshtaba* emulsion samples had a higher pH (5.97 ± 0.06) as compared to cold-processed samples (5.87 ± 0.05). The pH values observed in the present study were slightly lower than those reported by Samoon (1988) in their study. A similar finding was reported by Hussain et al. (2015) in the case of *Goshtaba* treated with α-tocopherol. The pH values of *Goshtaba Yakhni* samples followed a trend similar to that observed in the raw emulsions. However, the pH values of *Yakhni* samples were comparatively lower (in the range of 4.80) than the raw emulsions (in the range of 5.8-5.90). The relative decrease in the pH values of *Yakhni* samples might be attributed to the use of curd (pH 3.7-4) in the preparation of *Goshtaba Yakhni*. Our results are in close accordance with those found by Hussain et al. (2017).

Table 1: Effect of method of preparation and fat replacer on the physico-chemical quality of raw emulsion for low-fat Goshtaba

	Method of Preparation**			
Parameter*	**Traditional**		**Machine**	
	T_0	T_1	M_0	M_1
pH	$5.90^b \pm 0.02$	$5.92^b \pm 0.01$	$5.80^a \pm 0.01$	$5.81^a \pm 0.01$
Emulsion stability	$8.18^b \pm 0.02$	$6.36^a \pm 0.04$	$9.59^c \pm 0.06$	$8.19^b \pm 0.03$
Moisture (%)	$70.67^a \pm 0.29$	$71.82^b \pm 0.13$	$71.74^b \pm 0.13$	$71.87^b \pm 0.19$
Protein (%)	16.03 ± 0.17	16.44 ± 0.15	16.19 ± 0.23	16.35 ± 0.11
Fat (%)	9.90 ± 0.20	10.08 ± 0.23	9.90 ± 0.12	10.03 ± 0.07
Ash (%)	$2.22^b \pm 0.01$	$2.23^b \pm 0.01$	$2.26^b \pm 0.20$	$2.15^a \pm 0.03$

Means (±SE) with same superscripts row-wise do not differ significantly ($P>0.05$).

* n = 9/Treatment for pH and moisture; 6/Treatment for other parameters

**T_0/M_0: Control; T_1/M_1: Oatmeal @10%.

The emulsion stability (expression of percent cooking loss) of oatmeal supplemented emulsion (T_1) prepared by the traditional method was significantly better (indicated by lower values) than the rest of the formulations. Similarly, the emulsion stability of machine-made oatmeal formulated emulsion (M_1) was significantly better than that of its control (M_0). However, between the two controls (T_0 and M_0) and also between the two treatments (T_1 and M_1) significant differences were observed and comparatively the traditionally made emulsions (T_0 and T_1) were better ($P<0.05$) as indicated by their lower values. Samoon (1988) in his study on *Goshtaba* and *Rista* reported that the hot processed emulsions were more stable with a lower cooking loss as compared to the cold-processed samples. He further revealed that traditionally prepared emulsions were more stable as compared to machine-made samples. Our result was also in agreement with Serdaroglu and Sapanci (2003) and Jalal et al. (2014).

Table 2: Effect of method of preparation and fat replacer on the physico-chemical quality of low fat *Goshtaba*

Parameter*	Method of preparation**			
	Traditional		Machine	
	T_0	T_1	M_0	M_1
pH	$5.63^a \pm 0.02$	$5.68^b \pm 0.02$	$5.62^a \pm 0.01$	$5.60^a \pm 0.01$
Cooking yield (%)	$97.78^{bc} \pm 0.82$	$99.28^c \pm 0.23$	$94.04^a \pm 1.29$	$96.34^{ab} \pm 0.88$
Moisture (%)	$69.64^a \pm 0.17$	$70.62^{bc} \pm 0.10$	$71.07^b \pm 0.27$	$70.07^{ac} \pm 0.27$
Protein (%)	$16.00^b \pm 0.09$	$16.16^b \pm 0.15$	$15.84^a \pm 0.06$	$16.01^a \pm 0.21$
Fat (%)	$9.56^b \pm 0.13$	$10.06^b \pm 0.08$	$9.24^a \pm 0.02$	$9.96^c \pm 0.06$
Ash (%)	$2.49^b \pm 0.01$	$2.35^a \pm 0.02$	$2.45^b \pm 0.01$	$2.26^a \pm 0.01$

Means (±SE) with same superscripts row-wise do not differ significantly (P>0.05).

*n = 9/Treatment for pH and moisture; 6/Treatment for other parameters.

**T /M_0: Control; T_1/M_1: Oatmeal @ 10%

Under both methods of preparation, the oatmeal formulated *Goshtaba* (T_1, M_1) recorded a relatively higher percent cooking yield as compared to the controls (T_0, M_0) samples ((Table 2). Between T_1 and M_1 samples, significant differences in the cooking yield were observed and the value for traditionally prepared *Goshtaba* samples was significantly higher (P<0.05) than that of machine-made (M_1) samples. The higher cooking yield of hot processed *Goshtaba and Rista* balls in comparison to cold processed balls was reported by Samoon (1988) and similar results were reported by Hussain et al. (2017) in *Goshtaba* treated with -tocopherol. The cooking yield was higher in a traditionally prepared product as compared to machine prepared *Goshtaba* balls which correlated with emulsion stability values reported above. It might be due to the fact that traditional pounding of lean caused more efficient protein extraction, better fat dispersion into the protein matrix, and greater emulsification. This in turn caused better binding and emulsion stability and thus, low-fat losses into gravy on cooking in traditionally processed as compared to machine minced low-fat *Goshtaba.* This was in agreement with the findings of Jalal et al. (2015). Pinero et al. (2008) also reported significant (P<0.05) improvements in the cooking yield of low-fat beef patties formulated with oat fibre as a fat replacer and attributed it to the water binding ability of β-glucan.

Table 3: Physico-chemical quality of low-fat *Goshtaba* gravy (*Yakhni*)

Parameter*	Method of preparation**			
	Traditional		Machine	
	T_0	T_1	M_0	M_1
pH	$4.82^a \pm 0.01$	$4.82^a \pm 0.02$	$4.85^b \pm 0.01$	$4.84^b \pm 0.01$
Moisture (%)	$79.18^{abc} \pm 0.13$	$78.88^a \pm 0.17$	$79.46^c \pm 0.24$	$79.22^{abc} \pm 0.19$
Protein (%)	3.33 ± 0.01	3.16 ± 0.05	3.29 ± 0.11	3.16 ± 0.07
Fat (%)	$12.27^a \pm 0.01$	$12.06^a \pm 0.05$	$13.10^b \pm 0.20$	$13.02^b \pm 0.20$
Ash (%)	2.76 ± 0.04	2.73 ± 0.01	2.71 ± 0.04	2.76 ± 0.01

Means (±SE) with same superscripts row-wise do not differ significantly (P>0.05).

*n = 9/Treatment for pH and moisture; 6/Treatment for other parameters.

**T_0/M_0: Control; T_1/M1: Oatmeal @ 10%.

The percent moisture content of traditionally prepared hydrated oatmeal formulated emulsion (T_1) was significantly higher (P<0.05) than its control (T_0). However, no such difference was observed in the case of machine made (M_0 and M_1) emulsions as their moisture values were similar (Table 3). Between the two oatmeal formulated emulsions (T_1 and M_1) also non-significant differences (P>0.05) were observed. In the case of the cooked product (low fat *Goshtaba* balls) the percent moisture values of traditionally prepared oatmeal formulated (T_1) *Goshtaba* samples were significantly higher than that of its control (T_0) as in the raw emulsion. However, in the machine method the oatmeal formulated samples exhibited significantly lower moisture content as compared to its control

(M_0). Between the two oatmeal formulations (T_1 and M_1) non-significant differences were observed as was the case with their raw emulsions, the percent moisture of the gravies of oatmeal formulated low fat *Goshtaba* were statistically similar (P>0.05) to that of the gravies of their respective control. Between the gravies of T_1 and M_1 or T_0 and M_0 also non-significant differences were observed. Jalal et al. (2014) reported that hot processed and traditionally formulated cooked *Goshtaba* balls had lower moisture content as compared to cold processed and machine minced balls respectively which is in tune with the finding of the present study.

Non-significant differences (P>0.05) in percent protein values existed between the oatmeal formulated raw emulsions (T_1/M_1) and control (T_0/M_0) under both methods of preparation and all the values were statistically similar. In the case of the cooked product (low fat *Goshtaba* balls) also, the differences in percent protein between the oatmeal formulated *Goshtaba* samples and control were non-significant (P>0.05) and their values were statistically similar. Relatively the values were higher for oatmeal formulated samples. However, between the two controls (T_0 and M_0) or the oatmeal formulations (T_1 and M_1), the differences were significant and the values were higher (P<0.05) under the traditional method of preparation. There was a non-significant difference between the percent protein values of the *Yakhni* samples under each method of preparation. Relatively, the protein content was higher for the gravy of T_0; lower for M_0, and intermediate for T_1 and M_1. The higher emulsion stability of oatmeal formulated *Goshtaba* samples might have caused higher retention of protein in the product at the time of cooking and thus a relatively lower protein loss in the respective gravy. These findings were in agreement with Hussain et al. (2015, 2017) who also reported increased protein contents in those *Rista Goshtaba* samples which exhibited higher emulsion stability values and thus lower losses in the respective gravies.

Non-significant differences (P>0.05) in percent fat values existed between the oatmeal formulated raw emulsions (T_1/M_1) and control (T_0/M_0) under both methods of preparation and all the values were statistically similar. In the case of the cooked product (low fat *Goshtaba* balls) the oatmeal formulated (T_1/M_1) samples exhibited significantly higher (P<0.05) percent fat than that of their control (T_0/M_0) under both methods of preparation. However, between the two oatmeal formulations (T_1 and M_1) non-significant differences (P<0.05) in fat contents were observed. The percent fat values of *Yakhni* samples of oatmeal formulated *Goshtaba* (T_1/M_1) were statistically similar (P<0.05) to that of the *Yakhni* of control (T_0/M_0) under both methods of preparation. However, the values were relatively higher for the controls. Between the *Yakhni* samples of oatmeal formulated (T_1 and M_1) *Goshtaba* or the control (T_0 and M_0) significant differences in percent fat values were observed, the values being comparatively higher (P<0.05) under the machine method. These results were in consonance with the observed changes in moisture and protein contents discussed above. The higher fat content of oatmeal formulated cooked samples might be due to better fat retention in them owing to higher emulsion stability values thus causing lower fat losses in the respective gravies. These findings correlate well with the findings of Hussain et al. (2015, 2017) who reported significantly higher (P<0.05) fat levels in hot boned, traditionally minced *Rista* and *Goshtaba* samples owing to their higher emulsion stability values.

The percent ash values of oatmeal formulated (T_1) and control (T_0) raw emulsions were statistically similar (P>0.05) under the traditional method of preparation. However, in the case of the machine method the percent ash value of oatmeal formulated (M_1) raw emulsion was significantly lower (P<0.05) than that of its control (M_0). Between the two controls (T_0 and M_0) the differences in percent ash values were non-significant. However, between the oatmeal formulations (T_1 and M_1) the differences were significant and T_1 had a value higher (P<0.05) than that of M_1 emulsion. In cooked products (low fat *Goshtaba* balls) significant differences were observed between the percent ash values of control (T_0/M_0) and oatmeal formulated (T_1/M_1) *Goshtaba,* the values being higher (P<0.05) in the control under both methods of preparation. However, between the controls (T_0 and M_0) or oatmeal formulations (T_1 and M_1), the differences were non-significant and the percent fat values were similar (P>0.05). Relatively, the values of control were higher. In the *Yakhni* sample, non-significant differences (P>0.05) were observed and all the four values were statistically similar. Sofi et al. (2010) also reported no significant differences in the ash content among *Rista* samples obtained from high, medium, and low standard restaurants. However, Dawkin et al. (2001) in their study on goat/rabbit meat patties reported higher ash values for oatrim and oatgum at 1 and 2% levels as compared to the control.

Table 4: Effect of method of preparation and fat replacer on the sensory quality of low-fat *Goshtaba*

Sensory attributes[1*]	Method of preparation[**]			
	Traditional		Machine	
	T_0	T_1	M_0	M_1
Appearance	6.40 ± 0.09	6.53 ± 0.09	6.30 ± 0.08	6.33 ± 0.08
Flavour	6.36 ± 0.09	6.46 ± 0.09	6.23 ± 0.08	6.30 ± 0.08
Juiciness	6.36 ± 0.09	6.43 ± 0.09	6.20 ± 0.07	6.28 ± 0.08
Texture	6.30^{ab} ± 0.08	6.50^{b} ± 0.09	6.10^{a} ± 0.05	6.36^{b} ± 0.09
Mouth coating	7.06 ± 0.05	7.10 ± 0.06	7.10 ± 0.05	7.00 ± 0.01
Overall palatability	6.33^{b} ± 0.08	6.56^{b} ± 0.09	6.13^{a} ± 0.06	6.36^{b} ± 0.09

Means (±SE) with the same superscripts row-wise do not differ significantly (P>0.05).
1: 8-Point Descriptive Scale (8=extremely desirable; 1=extremely undesirable). *n = 30/Treatment.

**T_0/M_0: Control; T_1/M_1: Oatmeal @ 10%.

Appearance, flavour, juiciness, and texture scores of oat flour formulated traditionally (T_0) prepared *Goshtaba* samples were significantly higher (P<0.05) than those of the machine (M_0) made samples (Table 4). The better appearance of the oat flour formulated samples might be attributed to more desirable colour, better fat dispersion, and better binding leading to a more uniform cross-sectional appearance as compared to the control *Goshtaba* samples. Similarly, better emulsion stability of the batter offered by the addition of oat flour might have been responsible for the better texture of traditionally prepared *Goshtaba* samples as compared to the machine-made samples. Jalal et al. (2014) also reported similar findings in traditionally minced *Goshtaba* samples owing to their superior particle binding characteristics and which was in agreement with our study. The scores for mouth coating of oatmeal formulated *Goshtaba* samples and the control were statistically similar (P>0.05) and their values were akin to each other under both methods of preparation. Mouth coating ranged from traces to practically none (6-7) which is expected for such low-fat meat products. Our results are in agreement with the findings of Sofi et al. (2008). The scores for the overall palatability of T_1 were relatively higher than that of T_0. The scores for machine-made oatmeal formulated (M_1) samples were significantly higher (P<0.05) than that of its control (M_0). Between the two oatmeal formulations (T_1 and M_1) the differences in the overall palatability scores were non-significant. However, between the control (T_0 and M_0) the differences were significant with T_0 scoring higher (P<0.05) than that of M_0. Overall palatability generally reflects the overall quality of the product, in terms of other attributes i.e. appearance, flavour, juiciness, and texture. The trend similar to that observed for these attributes was also evident in the overall acceptability scores of traditionally prepared oatmeal formulated *Goshtaba* samples. These results correlate well with the findings of Hussain et al. (2017) and Heena et al. (2017) in hot-boned and traditionally minced *Rista Goshtaba* samples.

CONCLUSION

The results of this investigation indicate that traditionally processed low fat *Goshtaba* formulated with 10% oatmeal was superior to that of machine minced product. The addition of oatmeal as a fat replacer appeared essential to obtain low-fat *Goshtaba* of desired quality in case it was processed by employing machine mincing. Thus, it can be concluded that the introduction of mechanization in product preparation, saves time and energy but to compete with the traditionally processed *Goshtaba*, further research is needed.

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