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Evaluation of hydrated oatmeal as fat replacer on the shelf life of low fat *goshtaba*

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Lean mutton and fat was purchased from the local market and used for the preparation of the products within 2 h of post-mortem. The product was prepared following the standardized procedure and of Samoon (1988) with slight modifications. The basic formulation (Table 1), without any modification, served as control (T_0) and batter supplemented with hydrated oatmeal @ 10% served as treatment–1 (T_1).

Analytical procedure: Moisture content was estimated as per AOAC (1995). Standard methods were used to estimate pH of the cooked samples (Keller *et al.* 1974), of thiobarbituric acid (TBA) value (Witte *et al.* 1970) with slight modifications, total plate count (Maturin and Peeler 2001), coliform count (Feng *et al*. 2002) and yeast and mould count (Tournas *et al*. 2001). For sensory quality evaluation (Seman *et al.* 1987), the product served hot to a group of not less than 8 semi-trained panelists.

Table 1. Basic formulation for low fat goshtaba

Ingredient	Percentage
Mutton (boneless)	90
Mutton fat	10
Total	100.00
To the above, following ingredients were added on per cent weight basis	
Common salt	2.50
Chilled water/ ice flakes	10.00
Large cardamom seeds	0.20

Statistical analysis: The data obtained from three replications were pooled and then analyzed by ANOVA using the SPSS statistical package program (SPSS-Base 17.0).

The physico-chemical and microbiological quality of the cooked product (low fat *goshtaba* balls) are depicted in Tables 2 and 3 respectively.

The overall mean pH of hydrated oatmeal formulated (T_1) low fat *goshtaba* remained significantly lower than that of the control during the refrigerated storage period of 20 days. The values at day 20 were significantly higher than their values at day 15. Kumar and Sharma (2007) also concluded that low-fat ground pork patties with 15% added water remain stable without any appreciable change in pH during aerobic refrigerated storage (4±1ºC) for 21 days. Jay (1996) reported that the pH gradually increased during aerobic storage probably because of accumulation of bacterial metabolites and deamination of proteins which

Table 2. Effect of refrigerated storage and fat replacer on the physicochemical quality of low fat goshtaba

Parameter*	Treatments**	Storage period (days)				
		0	5	10	15	20
pH	T_0	$5.30^{aB} \pm 0.01$	$5.32^{a} \pm 0.01$	$5.52^{bB} \pm 0.01$	$5.53^{b} \pm 0.01$	$5.96^{c} \pm 0.05$
	T_1	$5.27^{aA} \pm 0.01$	$5.31^{a} \pm 0.01$	$5.42^{bA} \pm 0.00$	$5.51^{c} \pm 0.01$	$5.88^{d} \pm 0.05$
Moisture (%)	T_0	$69.01^{aA} \pm 0.03$	$69.20^{bA} \pm 0.01$	$69.79^{cA} \pm 0.02$	$69.94^{dA} \pm 0.02$	$70.00^{dA} \pm 0.01$
	T_1	$69.96^{aB} \pm 0.01$	$70.01^{abB} \pm 0.01$	$70.07^{bB} \pm 0.01$	$70.44^{cB} \pm 0.04$	$70.79^{dB} \pm 0.04$
TBA (mg malonaldehyde/ kg) (mg	T_0	$0.15^{aB} \pm 0.01$	$0.15^{aB} \pm 0.01$	$0.19^{bB} \pm 0.01$	$0.19^{b} \pm 0.01$	$0.27^{cB} \pm 0.01$
	T_1	$0.14^{aA} \pm 0.01$	$0.14^{aA} \pm 0.01$	$0.18^{bA} \pm 0.01$	$0.19^{c} \pm 0.01$	$0.25^{dA} \pm 0.01$

Overall means (± SE) with common lower case superscripts row-wise and upper case superscripts column-wise for each parameter do not differ significantly (P>0.05). *n, 9/Storage interval/treatment for pH and moisture; 6/storage interval/treatment for TBA. ** T_0, control; T_1, hydrated oatmeal @ 10%.

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was in agreement with our findings.

The overall mean per cent moisture of T_1 *goshtaba* remained significantly higher than that of T_0 during the entire storage period. An increase in the percent moisture value of T_0 as well as T_1 was observed which became significant as the storage progressed. This might be due to a linear increase in pH of the samples.

The overall mean thiobarbituric acid (TBA) value of T_1 remained significantly lower ($P<0.05$) than that of T_0 during entire storage period. Witte *et al.* (1970) reported the threshold value of TBA at 1–2 mg of malonaldehyde per kg of meat. From the results it was clear that TBA values were low initially and remained low (less than what would be reported as rancid) throughout the entire period of storage.

The overall mean total plate count (TPC) of T_1 remained significantly lower than that of T_0 during the entire storage period of 20 days. An increase from day 0 to day 20 value of TPC in T_0 and T_1 was observed. However, even at the end of storage period, the counts were acceptable and well below the limits indicative of even initial spoilage changes. Viuda *et al*. (2010) reported that the incorporation of orange dietary fibre in bologna sausage stored in vacuum packaging showed lower TPC than control. Similar results were obtained by Verma *et al.* (2010) in low fat chicken nuggets. In general, TPC ranged from 1.84 to 2.76 log10 cfu/g during refrigerated storage which was far below the incipient spoilage level of 7.0 log10 cfu/g (Hytiainen *et al.,* 1975). The test samples did not reveal any counts of coliform organisms during the period of storage.

The overall mean yeast and mould (YMC) counts of T_1 remained significantly lower ($P<0.05$) than that of the T_0 during the entire period of storage. However, the YMC were detectable only on day 10 and the counts on day 20 were significantly higher than the counts at day 15. However, even the day 20 counts were quite acceptable and very well below the threshold limits indicative of even initial spoilage changes. This might be due to more acidic nature of

Table 3. Effect of refrigerated storage and fat replacer on the microbiological quality of low fat goshtaba

Parameter*	Treatments**	Storage period (days)				
		0	5	10	15	20
Total plate count (log_{10}cfu/g)	T_0	$1.91^{aB} \pm 0.02$	$2.05^{b} \pm 0.02$	$2.15^{cB} \pm 0.02$	$2.25^{dB} \pm 0.01$	$2.89^{eB} \pm 0.02$
	T_1	$1.77^{aA} \pm 0.01$	$2.06^{b} \pm 0.01$	$2.08^{bA} \pm 0.01$	$2.08^{bA} \pm 0.01$	$2.63^{cA} \pm 0.02$
Coliform count (log_{10}cfu/g)	T_0	ND	ND	ND	ND	ND
	T_1	ND	ND	ND	ND	ND
Yeast and mould count (log_{10}cfu/g)	T_0	ND	ND	$1.87^{aB} \pm 0.01$	$1.90^{bB} \pm 0.01$	$2.11^{cB} \pm 0.01$
	T_1	ND	ND	$1.69^{aA} \pm 0.05$	$1.87^{bA} \pm 0.01$	$1.93^{cA} \pm 0.03$

Overall means (± SE) with common lower case superscripts row-wise and upper case superscripts column-wise for each parameter do not differ significantly ($P>0.05$). *n, 9/storage interval/treatment for pH and moisture; 6/storage interval/treatment for TBA. ** T_0, control; T_1, hydrated oatmeal @ 10%.

Table 4. Effect of refrigerated storage and fat replacer on the sensory quality of low fat goshtaba

Sensory attribute[1*]	Treatments**	Storage period (days)				
		0	5	10	15	20
Appearance	T_0	6.58 ± 0.10	6.54 ± 0.10	6.50 ± 0.10	6.41 ± 0.10	6.37 ± 0.10
	T_1	6.66 ± 0.10	6.62 ± 0.10	6.62 ± 0.10	6.54 ± 0.10	6.45 ± 0.10
Flavour	T_0	6.75 ± 0.09	6.79 ± 0.08	6.75 ± 0.09	6.66 ± 0.09	6.66 ± 0.09
	T_1	6.91 ± 0.05	6.87 ± 0.06	6.87 ± 0.06	6.83 ± 0.07	6.75 ± 0.09
Juiciness	T_0	6.79 ± 0.08	6.75 ± 0.09	6.70 ± 0.09	6.62 ± 0.10	6.54 ± 0.10
	T_1	6.87 ± 0.06	6.83 ± 0.07	6.83 ± 0.05	6.75 ± 0.09	6.70 ± 0.09
Texture	T_0	6.50 ± 0.10	6.45 ± 0.10	6.41 ± 0.10	6.33 ± 0.09	6.33 ± 0.09
	T_1	6.58 ± 0.10	6.54 ± 0.10	6.50 ± 0.10	6.45 ± 0.10	6.41 ± 0.10
Mouth coating	T_0	7.00 ± 0.01	6.95 ± 0.20	6.91 ± 0.28	6.87 ± 0.33	6.87 ± 0.33
	T_1	7.00 ± 0.01	7.00± 0.01	6.95 ± 0.20	6.91 ± 0.28	6.87 ± 0.33
Overall palatability	T_0	6.50 ± 0.10	6.50 ± 0.10	6.37 ± 0.10	6.33 ± 0.09	6.33 ± 0.09
	T_1	6.58 ± 0.10	6.54 ± 0.10	6.58 ± 0.10	6.50 ± 0.10	6.41 ± 0.10

Overall means (± SE) with common lower case superscripts row-wise and upper case superscripts column-wise for each parameter do not differ significantly ($P>0.05$). *n, 9/storage interval/treatment for pH and moisture; 6/storage interval/treatment for TBA. ** T_0, control; T_1, hydrated oatmeal @ 10%. 1: 8-Point descriptive scale (8,extremely desirable; 1,extremely undesirable).

goshtaba yakhni (containing curd) which may have favoured the growth of fungi (yeast and moulds) as these are more acid tolerant (Frazier and Westhoff 1988). YMC were not detected during early period of storage study, which could be due to thorough cooking, good hygiene and absence of post processing contamination.

The overall mean appearance scores of hydrated oatmeal samples was higher than control samples but difference was non-significant (P>0.05). During refrigerated storage, a gradual non-significant decrease in the appearance scores was observed (Table 4). Vedamurthy (1998) and Bullock *et al*. (1994) also observed a decrease in appearance score during refrigerated storage in low fat ground beef patties under refrigerated storage and low fat chevon sausage respectively under refrigerated storage. The overall flavour and juiciness scores for T_1 were significantly higher (P<0.05) than that of the T_0. During refrigerated storage, a gradual decrease in the flavour and juiciness scores was observed. Samoon (1988) also reported a drop in the flavour scores of *rista* and *goshtaba* with the advancement of storage. Decrease in juiciness of *rista* and *goshtaba* samples with the advancement of storage might be due to decrease in fat retention as storage progressed (Samoon 1988). Vedamurthy (1998) also observed similar decrease in juiciness of low fat chevon sausages as well control. Non-significant differences between T_1 and T_0 texture, mouth coating and overall palatability scores were observed. The scores for various attributes tended to decrease non significantly as the storage period advanced. In general, the scores for oatmeal formulated low fat *goshtaba* were higher than the control. Similar trend of decreasing texture scores with the progress of storage was reported by Samoon (1988) in *rista* and *goshtaba.* Vedamurthy (1998) also observed decrease in textural score during refrigerated storage of low fat chevon sausage. The drop in the overall palatability scores during refrigerated storage was also reported by Samoon (1988) in *rista* and *goshtaba*. Vedamurthy (1998) also reported decrease in acceptability of low fat chevon sausages with increase in storage period. Thus, addition of hydrated oatmeal @ 10% along with just 10% fat in the formulation of *goshtaba* could result in a product with acceptable quality for 20 days at 4±1°C.

Although high fat content *goshtaba* with an average fat content of 15–25% is having a high sensory appeal but is associated with a number of health risk factors including cardiovascular diseases, obesity and cancer etc. From the present study of formulation of low fat *goshtaba* containing only 10% fat and supplemented with hydrated oatmeal as fat replacer, it was concluded that the low fat *goshtaba* supplemented with the hydrated oatmeal could be stored for 20 days at 4±1ºC without any adverse changes in its quality, stability and acceptability.

SUMMARY

The study was conducted to assess the quality, stability and acceptability of low fat *goshtaba*, prepared by traditional method and formulated with 10% hydrated oatmeal, evaluated at 5 day intervals following their packaging in LDPE bags and refrigerated storage at 4±1°C for a period of 20 days. The results indicated that overall pH, TBA values, total plate count and yeast and mould count of oatmeal formulated (T_1) *goshtaba* remained significantly lower than that of the control (T_0) during storage. The overall percent moisture of T_1 remained significantly higher than that of T_0 and no coliforms were detected. The overall sensory scores for flavour and juiciness of T_1 were higher than that of T_0. Non-significant differences between T_1 and T_0 in the overall scores for texture, mouth coating and overall palatability were observed. In general the scores for T_1 were higher than that of its control.

In *goshtaba*, a fat rich emulsion based meat product, fat plays a vital role in sensory properties (Jalal *et al.* 2014). However, as the dietary fat is considered as cause of cardiovascular diseases, hypertension and obesity (Wylie and Judith 2002) and the increased awareness of consumers about the health risks associated with meat and meat products, there is a need to reduce the fat content of *goshtaba* to a minimum. Hence, keeping in view the importance of *goshtaba* and associated health risks, a study was conducted to formulate low fat *goshtaba* (10% fat) with supplementation of oatmeal as fat replacer and its effect on the shelf life of *goshtaba*.

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