Methods of drying beef and buffalo meat on meat quality

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Abstract

Effects of method of drying beef and buffalo meat and storage time on quality were investigated. Six treatments were applied: drying beef with salt (B_1), drying beef without salt (B_2), drying beef with salt and spices (B_3), drying buffalo meat with salt (B_4), without salt (B_5) and with salt and spices (B_6). Taste and smell of all samples were acceptable up to 120 days of storage. The dry matter (DM), protein, ether extract (EE) and ash content decreased with storage time. The initial DM, crude protein (CP), EE and ash content of the samples were 92.1-95.2%, 77.0-78.6%, 5.0-6.5%, 8.0-12.8%, respectively. After 120 days of storage DM, CP, EE and ash content of the samples ranged from 87.8-89.1%, 72.9-74.0%, 5.0-5.9%, 7.4-9.7%, respectively. CP and EE percentage in beef was higher than buffalo meat, but beef contained less DM and ash. At the end of storage beef dried with salt contained highest protein (74.0%) and buffalo meat dried without salt contained lowest protein (73.0%). There was a significant ($p<0.05$ to 0.01) effect of drying method, salt and spices in beef and buffalo meat. With the elapse of storage time quality of meat degraded significantly ($p<0.05$ to 0.01). The degradation was lower in beef dried with salt than in beef dried without salt beef or beef dried with salt and spices, and buffalo meat. It is suggested that salt drying may be a useful method of meat preservation. (*Bangl. vet.* 2009. Vol. 26, No. 1, 31-38)

Introduction

Beef and buffalo meat are regarded as good sources of protein, vitamins and minerals, especially iron. There is a high demand of beef and buffalo meat in Bangladesh due to its palatability and good flavours (Islam, 2008).

Meat production and consumption in Bangladesh are poor. The per capita requirement and availability of meat are 12.0 and 12.6 g/ day, respectively, which implies an 89.5% deficit (Alam, 1993). The annual meat production in Bangladesh is about 0.744 million MT where beef contributes 0.183 million MT of the total meat production (FAO, 1997). The annual production of meat was increases day by day. The annual meat production in 2004 was 1020.2 thousand tonnes (BBS, 2005), equivalent to 7.4 kg meat/year/person, 60.6% from cattle, 1.3% from buffalo, 8.1% from goat, 0.9% from sheep and 29.1% from chicken and duck (BBS, 2005). Livestock in Bangladesh comprises 23.2 million cattle, 0.8 million buffaloes, 29.8 million goats, 1.0 million sheep, 11.5 million chickens and 13.5 million ducks (Alam *et al.*, 2001).

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About 23% of cattle are slaughtered every year about 7% at Eid-Ul-Azha, the largest Muslim festival (Alam, 1995). It is essential to preserve the meat when it is not consumed immediately. Stakeholders and meat sellers use the drying method only for household consumption for short time. During the monsoon, it is difficult to dry the meat. A major problem associated with drying of meat is fly infestation, which deteriorates the product.

Drying of meat reduces the water content so that microbes are unable to survive (Shawkat, 2008). Drying is easier than freezing and other preserving methods. There are no reports on the physical and nutritional features of drying meat. A systematic study is needed to determine the relationship between storage time and different parameters of dried beef and buffalo meat. The present study was undertaken to find the effect of drying on the quality of beef and buffalo meat.

Materials and Methods

Sample collection and preparation

Fresh boneless beef was collected from butcher shop in "K. R. Market", Bangladesh Agricultural University (BAU), Mymensingh at 9.00 am. Fresh boneless buffalo meat was collected from "Krishi Market" Mohammadpur, Dhaka city at 6.00 am and carried in polythene bags to the laboratory. All visible fat and connective tissue were trimmed off as far as possible. The muscle was cut into small pieces, rinsed and washed with clean water to remove blood. Then 100 gm meat samples were kept individually in plates. All of the meat pieces were mixed properly by hand. Beef samples were dried with salt (B_1), without salt (B_2), or with salt and spices (B_3); and buffalo meat was dried with salt (B_4), without salt (B_5) and with salt and spices (B_6).

Physical appearance

The fresh beef was reddish and bright, soft, fine, firm and elastic. Natural odour and intramuscular marbling was present. The raw buffalo meat was dark reddish and less bright, moderately soft, fine, firm and elastic. Natural meaty odour was present in raw buffalo meat.

Drying agents and duration

For drying with salt, 8% salt and 0.13% potassium nitrate were added, and for drying with spices 8% salt, 5 ml turmeric powder and 0.13% potassium nitrate were added. All the samples were dried properly. Samples were examined 0, 30, 60 and 120 days after storage.

Drying with salt, without salt and with salt and spices

For drying with salt, drying without salt, drying with salt and spices; salt, KNO_3, beef and buffalo meat were mixed thoroughly in different plates. After proper mixing beef and buffalo meat were taken into six separate petridishes and kept in the oven at

50°C temperature for 7 days until proper drying. In case of drying with salt and spices, turmeric powder were used with required amount.

Storage

The samples were stored in separate polyethylene bags at room temperature up to 120 days.

Proximate analysis

Proximate analysis of crude protein, fat, ash and moisture were carried out according to the methods of AOAC (2003). All determinations were done in triplicate and the mean value was recorded.

pH measurement

The pH was measured using pH meter in meat homogenate, prepared by blending 2 g of meat with 10 ml distilled water.

Statistical analysis

Data were analysed using the analysis of variance technique in MSTAT computer program with completely randomized block design (RBD). Duncan's new multiple range test (DMRT) was done to compare variations between treatments where ANOVA showed significant differences. SEM values were calculated to identify differences between means.

Results and Discussion

Chemical composition of fresh beef and buffalo meat

The DM, ash, protein and fat percentage of fresh meat are shown in Table 1. The DM (%) ranged from 24.4-25.6 for beef and 25.2-25.6 for buffalo meat. The CP (%) content ranged from 21.4-21.7 for beef and 20.7-21.1 for buffalo meat. The EE (%) content ranged from 3.0-3.2 for beef and 2.7-2.9 for buffalo meat. The ash (%) content ranged from 0.96-1.02 for beef and 0.98-1.04 for buffalo meat. The pH of fresh beef and buffalo meat was 5.8 and 5.6, respectively.

Table 1. Chemical composition of fresh beef and buffalo meat

Parameter	Fresh meat sample	
	Beef	buffalo meat
DM %	25.2 ± 0.67	25.5 ± 0.23
Ash %	1.99 ± 0.03	1.0 ± 0.03
CP %	21.6 ± 0.14	20.9 ± 0.21
EE %	3.1 ± 0.12	2.8 ± 0.10
pH		
Day 0	5.8 ± 0.12	5.6 ± 0.15
Day 10	5.2 ± 0.09	4.7 ± 0.12

DM dry matter; CP crude protein; EE ether extract

Proximate analysis

Dry matter

The initial dry matter was 92.1 to 95.2%, and after 120 days of storage slightly lower at 87.8 to 89.2%. DM decreased with storage period in all samples. The same trend was observed by Konieczny *et al.* (2007) who reported that DM decreased during frozen storage.

Ash

The initial value of ash ranged from 8.0 to 12.8% and after 120 days of storage it had decreased to 7.4 to 9.7% as weight basis.

Crude protein

The initial protein content was 77.0 to 78.6 % and at the end of 120 days of storage had decreased to 73.0 to 74.0%. The loss of protein may be related to loss of sarcoplasmic protein due to osmosis and poor water-holding capacity. The result is similar to that of Baowu *et al.* (1997). Konieczny *et al.* (2007) showed decreased protein content of frozen beef.

Ether extract

The initial ether extract content was 5.0 to 6.5% and gradually decreased. At the end of 120 days, the values were 5.0 to 5.8%. The decrease of fat content is probably associated with the presence of potassium nitrate.

Effects of storage time (day) on different parameters

Effect of storage period is presented in Table 4 and 5. It shows that the initial DM was 93.6%. After 120 days this value reached to 88.5%. The DM of the meat sample was significantly different ($p<0.01$) from each other at different time.

The initial ash was 10.2%. At the end of storage, this value changed to 8.4% (Table 2). The ash content of the meat sample was almost similar ($p>0.01$) from each other at different time.

The initial CP was 77.8%. At the end of 120 days this value reached to 73.5% (Table 2). The CP content of the meat sample significantly differed ($p<0.01$) from each other at different time. Protein content may be reduced during storage. The results are supported by Sarma *et al.* (1994); Baowu *et al.* (1997).

The initial EE was 5.8%. After 120 days this value changed to 5.5% (Table 2). The fat content of the meat sample was non-significant ($p>0.05$) from each other at different time.

Effects of preservation method on nutrient content

Effects of different preservation methods of meat are shown in Table 3. The DM% of all the samples were similar. The ash percentage of the samples of buffalo meat

preserved with salt and spices (B6) was significantly higher than in those preserved with salt (B4) (p<0.01). Protein content of all samples was similar (p>0.01). Ether extract was highest in B_6 (6.1%) and lowest in B_6 (5.0%). Differences in percentage of ether extract in all samples were significant within species (p<0.01).

Table 2. Effect of storage time (day) on nutrient content

Parameter (%)	Days				SEM value	Significance
	0	30	60	120		
DM	93.6[a]	90.7[b]	89.1[c]	88.5[c]	0.44897	**
Ash	10.2	9.0	8.5	8.4	0.26394	NS
CP	77.8[a]	76.7[b]	74.3[c]	73.5[c]	0.38958	**
EE	5.8	5.7	6.0	5.5	0.08263	NS

Mean with different super scripts within the same row differ significantly; ** Significant at 1% level, DM dry matter; CP crude protein; EE ether extract

Table 3. Effects of preservation methods on nutrient content

Parameter (%)	Sample				SEM value	Significance
	B_1	B_2	B_3	B_4		
DM	89.5	91.1	90.2	90.1	0.45	NS
Ash	7.6[c]	8.9[bc]	8.6[bc]	8.3[b]	0.26	**
CP	75.6	75.9	75.7	75.4	0.39	NS
EE	6.1[a]	5.5[c]	5.9[b]	5.8[b]	0.08	**

Mean with different superscripts within same row differ significantly; ** Significant at 1% level, NS = Non significant; B_1 beef treated with salt, B_2 without salt, B_3 with salt and spices; B_4 buffalo meat treated with salt, B_5 without salt, B_6 with salt and spices; DM dry matter; CP crude protein. EE ether extract.

Storage time and preservation method

The interaction of storage time and preservation methods are summarized in Table 4. With the elapse of time meat degraded significantly (p<0.01).

Effects of species on different parameters

The DM content of all the paired samples were not significantly different (p>0.01) (Table 5). The ash content of all paired samples were significantly different (p<0.01) except B_1 and B_4 (Table 5). The fat content of all paired samples were significantly different (p<0.05 to 0.01) from each other except B_2 and B_5 (Table 5). The protein content of all paired samples were not significantly different (p>0.01) from B_2 and B_5 (Table 5).

Coefficient of Determination (R^2) was used to test the hypothesis concerning the relationship between two variables and 0.05 level of' significance used as the basis for rejection of a hypothesis.

Table 4. Interaction of sample and storage time

Parameter periods		Treatment						SEM value	Sig.
		B_1	B_2	B_3	B_4	B_5	B_6		
DM	0	92.1	94.2	92.7	93	94.6	95.2	0.43401	NS
	30	88.9[b]	91.7[a]	89.8[b]	90.3[ab]	91.8[a]	91.9[a]	0.34118	**
	60	88.7	89.5	89.6	89	89.1	88.9	0.18361	NS
	120	88.2	89.1	88.7	88.2	87.8	89.1	0.32229	NS
Ash	0	8[c]	9.8[b]	9.5[b]	9.3[bc]	11.6[a]	12.8[a]	0.40911	**
	30	7.7[c]	8.8[b]	8.8[b]	8.8[b]	9.8[a]	10.1[a]	0.21609	**
	60	7.4[d]	8.5[c]	8.4[c]	7.5[d]	9.2[b]	9.8[a]	0.20652	**
	120	7.4[d]	8.5[c]	8.4[c]	7.4[d]	9.2[b]	9.7[a]	0.20416	**
Crude protein	0	78.1	78.6	77.9	77.6	77.2	77.0	0.26949	NS
	30	76.2	76.3	76.2	76.7	76.0	78.9	0.35241	NS
	60	74.2	74.9	74.8	74.0	73.6	73.9	0.33638	NS
	120	74.0	74.0	73.9	73.0	72.9	73.0	0.33671	NS
EE	0	6.5[a]	5.5[bc]	6.0[ab]	6.0[ab]	5.5[bc]	5.0[c]	0.14803	*
	30	6.2[a]	5.5[c]	6.0[b]	5.9[b]	5.5[c]	5.0[d]	0.09614	**
	60	6.0[a]	5.5[b]	5.9[a]	5.8[a]	5.3[bc]	5.1[c]	0.08255	**
	120	5.9	5.4	5.8	5.7	5.2	5.0	0.12241	NS

Means with different superscripts within same row differ significantly; ** Significant at 1% level, * Significant at 5% level DM dry matter

Table 5. Effects of species on nutrient content

Parameter (%)	Samples	Beef	Buffalo meat	P-Value	Level of significance
DM	$B_1 - B_4$	89.5	90.1	0.129	NS
	$B_2 - B_5$	91.1	90.8	0.479	NS
	$B_3 - B_6$	90.2	91.3	0.245	NS
Ash	$B_1 - B_4$	7.6	8.25	0.159	NS
	$B_2 - B_5$	8.9	9.9	0.026	*
	B_3 B_6	8.8	10.6	0.030	*
CP	$B_1 - B_4$	75.6	75.4	0.401	NS
	$B_2 - B_5$	75.9	75.0	0.021	*
	$B_3 - B_6$	75.7	75.7	0.99	NS
EE	$B_1 - B_4$	6.1	5.8	0.023	*
	$B_2 - B_5$	5.5	5.4	0.166	NS
	$B_3 - B_6$	5.9	5.0	0.001	**

Means with different superscripts within same row differ significantly; ** Significant at 1% level, * Significant at 5% level, NS = Non significant; DM dry matter; CP crude protein; EE ether extract

Storage time and nutrient content

Dry matter and storage time

The computed "R²" value for the storage time was 0.7982 (Fig. 1) indicating that the relationship between DM and storage time was significant (p<0.01). It was concluded that DM had significant positive relationship with the storage time.

Ash and storage time

The computed "R²" value for the storage time was 0.6963 (Fig. 2). The relationship between ash and storage time was not significant.

Crude protein and storage time

The computed value of "R²" for the storage time was 0.8885 (Fig. 3) (p< 0.01). Therefore, it was concluded that crude protein had a highly significant positive relationship with storage time.

Ether extract and storage time

The computed "R²" value for the storage time was 0.9598 (Fig. 4). The relationship was not significant.
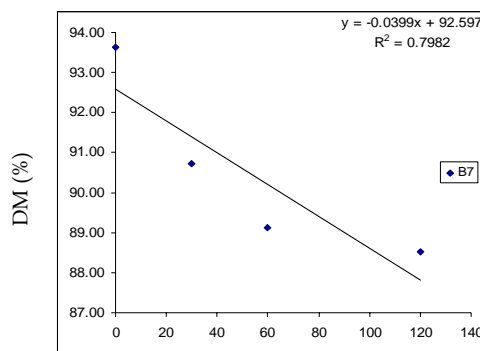
Fig. 1. Relationship between dry matter and storage time
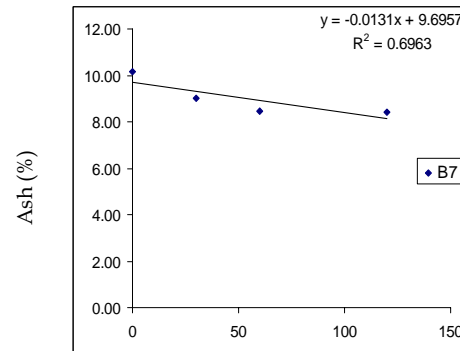
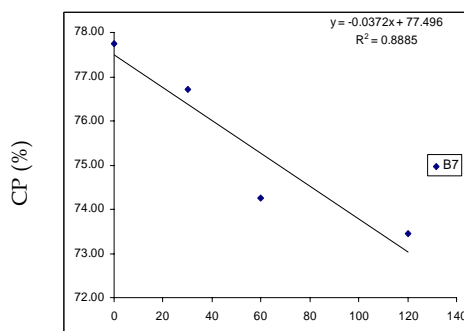Fig. 2. Relationship between ash and storage time

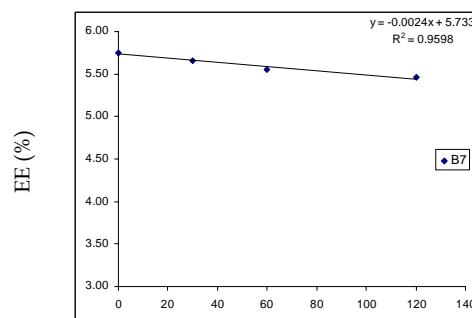Fig. 3. Relationship between crude protein storage time

Fig. 4. Relationship between ether extract and storage time

Conclusions

It can be concluded that storage time is closely related with the nutrient content of meat. Salt drying may be a useful method of beef and buffalo meat preservation.

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