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Effects of drying as a preservation technique on nutrient contents of beef

S. Akhter, M. Rahman, M. M. Hossain and M. A. Hashem
Department of Animal Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Abstract

Effects of different drying methods (sun drying, oven drying & rural cooker smoking) and meat size (block, flat & mince) on the nutrient content of beef was investigated with cooked cured (CC) or non-cooked cured (NC) beef. Both physical and chemical assessment were done to assess the quality of meat. Organoleptically all the samples were in acceptable condition upto 120 days of storage time. The initial (30 days) DM, CP, EE and ash content, of the samples (g/100 g DM) were ranged from 81.32-90.00, 69.00-80.16, 2.90-5.23 and 15.00-18.01, respectively. The DM, CP and EE decreased and ash content increased with increasing storage time. At the end of 120 days of storage the DM, CP, EE and ash content of the samples (g/100 g DM) ranged from 79.00-87.36, 67.24-77.92, 1.90 – 4.00 and 19.00 - 24.70, respectively. DM and CP content in cooked meat was higher than non-cooked meat. However, cooked meat contains less EE and ash value than non-cooked meat. At the end of storing time rural smoked cooked block contain highest protein (77.92%) and oven dried non-cooked mince meat (67.24%) contain lowest protein percent. Statistical analysis revealed that there was a significant ($P<0.5$ to 0.01) effect of drying methods and meat size on cooked or non-cooked meat. The nutrient contents of meat sample degraded significantly ($P<0.05$ to 0.01) with the elapse of storage time. The quality decreasing trend was lower in smoked, cooked, flat size meat sample. From this study it was observed that rural cooker smoking method of meat drying could be a useful technique of meat preservation.

Keywords: Drying methods, Meat sizes, Beef preservation and Nutrient content

Introduction

Meat plays an important role in nutrition as a contributor of high quality protein. Meat protein also plays important physiological role in that it promotes iron absorption and prevents calcium losses. The B-vitamins and mineral contents of meat are important nutritional factor. People of Bangladesh get less than one fifth animal protein of the required recommendation (Chawdhury *et al,* 1993), which reflect the extreme shortage in supply of meat for human consumption.

Livestock population in Bangladesh comprises 23.2 million cattle, 0.78 million buffaloes, 29.75 million goats, 1.04 million sheep, 11.48 million chickens and 13.47 million ducks (Alam *et al.,* 2001). The per capita requirement and availability of meat per day are 120 g and 12.61 g, respectively in Bangladesh, which figures 89.50 percent deficit for human consumption (Alam, 1993). The annual meat production was 559.00 thousand metric tons (BBS, 2005), where 60.6% of the total came from cattle, 1.3% from buffalo, 8.1% from goat, 0.9% from sheep and 29.1% from chicken and duck.

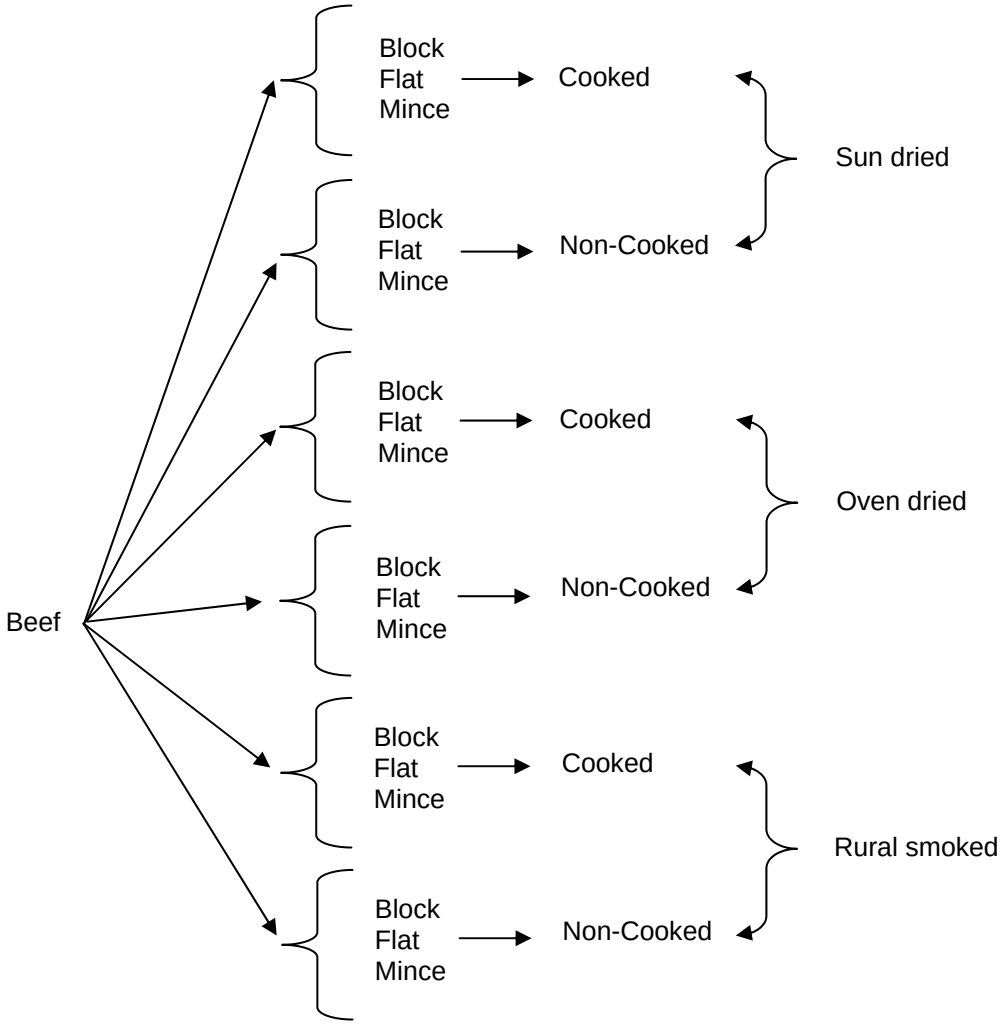
Twenty three per cent of total cattle are being slaughtered every year in Bangladesh. The extent of slaughtering is about 7% on a single occasion like Eid-Ul-Azha. The remaining 16% is slaughtered throughout the year (Alam, 1995). So it is seen that a good amount of meat production is occurred in special occasion which needs to be preserved for further use and consumption. Unfortunately we do not have appropriate techniques of meat preservation that are suitable for our country. Some butchers, meat sellers and urban housewife use freezing technique (Azad and Akhter, 2005) and in most rural areas meat is being preserved by sun drying. A major problem associate with sun drying of meat is the infestation of fly and insect larvae during drying and storage which deteriorate the product before consumption. Besides this sun drying is problem during monsoon period. In Bangladesh, the meat is smoked and dried mainly by the village women who are mostly illiterate and have no scientific knowledge about its quality. Obviously, their products do not meet the quality standards. In this background appropriate drying methods, size of meat and cooking status (cooked or non-cooked) are needed to investigate for quality meat preservation. There is no information on the physical and nutritional features of drying of meat in Bangladesh. Therefore, the present study has been undertaken to observe the effect of drying as a preservation technique on nutrient contens of beef.

Materials and Methods

Boneless beef from freshly slaughtered cattle were purchased from local market at 8.00 A.M. The meat sample was immediately transferred to the “Animal Science Laboratory”. Before starting the experiment, 18 plastic jars were thoroughly cleaned and dried to keep samples.

All visible fat and connective tissues were trimmed off as far as possible with knife. The samples were prepared as block, flat (2 inches long, 1 inch wide and 3-6 milimeters thick) and mince. Half of the block and flat meat samples were cooked for 30 minutes in a saucepan and put into different plates. Rest of non-cooked block and flat meat samples were taken into different plates. The meat sample was grinded with the help of meat grinder. Half of the mince meat sample was cooked for 10 minutes in a saucepan. Cooking time was reduced to 10 minutes to avoid burning. This cooked mince meat sample was put into different plates. Rest of non-cooked mince meat sample was also taken into different plates. After preparing meat samples, curing agents (10 g salt, 125 mg potassium nitrate /100 g meat.) were added to them. After proper mixing of curing agent, the meat samples were kept in labeled jars. The jars were covered by very fine thin cloths and tied by thread. The duration of curing was 10 days.

Layout of the experiment



After 10 days of curing period all the samples were brought out from the jar and dried using several drying system such as oven drying, sun drying and rural cooker smoking. The meat sample was dried in sun shine for 6 days. The meat sample was hanged over traditional cooker used at rural level. It was taken 6 days for proper drying of the meat sample with rural cooker smoking. The temperature of oven was 50°C and meat sample was kept in the oven for 72 hours. The dried samples were packed in polyethylene bags and kept in plastic jar at the room temperature for further analysis. The observations were color, texture, smell and flavour over storage period. Proximate analysis such as DM, CP, EE, and ash were determined by the method of AOAC (2007). All determination was done in triplicate.

Data were analyzed statistically using the analysis of variance technique in a computer using MSTAT statistical computer package programme in accordance with the principle of completely randomized block design (CRBD). Duncan's new multiple range test (DMRT) was done to compare variations between treatments where ANOVA showed significant differences. Standard Error of Mean values were calculated to identify differences among means.

Results and Discussion

Chemical composition

The chemical composition of fresh beef is shown in Table 1. The DM (%) content ranged from 35.10-36.20 for cooked meat and 23.00-23.32 for non-cooked meat. The CP (%) content ranged from 28.47-29.43 for cooked meat and 18.86-19.15 for non-cooked meat. The EE (%) content ranged from 2.81-3.07 for cooked meat and 1.86-1.98 for non-cooked meat. The ash (%) content ranged from 1.47-1.55 for cooked meat and 0.95-0.98 for non-cooked meat. Fidanza (1982) reported that DM content of beef was 28% which was higher than non-cooked meat. He also found EE content of cattle was 3.1% that is higher than this non-cooked meat but similar to cooked meat. Moran (1986) found the protein content of Zebu cattle was 19.8%. This result was similar to this non-cooked meat. Lapital *et al*. (2004) estimated the ash content of beef was 1.17% which was similar to the results of the present study.

Table 1. Chemical composition of fresh beef (g/100 g)

Parameter	Fresh beef					
	Cooked			Non-cooked		
	Block	Flat	Mince	Block	Flat	Mince
DM	35.10	36.20	36.10	23.00	23.20	23.32
CP	28.47	29.43	29.28	18.91	18.86	19.15
EE	2.81	2.89	3.07	1.96	1.86	1.98
Ash	1.47	1.55	1.53	0.96	0.95	0.98

Effects of drying methods

The chemical composition of sun dried, oven dried and rural cooker smoked meat varied due to different drying system. Effects of the drying methods on different parameters are shown in Table 2. At 120 days, the oven dried sample contain significantly higher amount of DM% than other two samples. The DM value gradually decreased with elapse of storage time. This might be due to salt penetration into the meat during treatment. The rural smoked meat contain significantly higher amount of CP% than other two drying methods. The protein value gradually decreased with increasing preservation time. At the end of storage time there were also significant differences ($P<0.01$) among three drying methods. At 120 days, the loss of protein in sun dried, oven dried and rural smoked was 3.22%, 3.19% and 2.08%, respectively. The protein value of smoked meat was significantly higher and loss of protein was less. The wood smoke contains pyroligenous acid which may have an added preservative effect on smoked dried meat. The maximum EE % was found in oven dried and minimum was in rural smoked meat. The average EE content decreased with the increase in storage time. At 120 days the ether extract content of oven dried sample was also significantly ($P<0.01$) higher than other two methods.

Table 2. Effects of drying methods on different parameters (g/100 g DM)

Parameter	Periods (days)	Treatment		
		Sun Dried	Oven Dried	Rural Smoked
DM	30	86.24[b]	88.90[a]	83.28[c]
	60	85.04[b]	86.92[a]	82.8[c]
	120	83.47[b]	85.61[a]	81.91[b]
CP	30	74.19[b]	75.25[b]	77.36[a]
	60	72.97[b]	73.79[b]	76.14[a]
	120	70.97[c]	72.06[b]	75.28[a]
EE	30	4.03[a]	4.28[a]	3.7[b]
	60	3.4[a]	3.65[a]	3.08[b]
	120	2.83[ab]	3.02[a]	2.55[b]
Ash	30	16.72[a]	16.49[ab]	16.21[b]
	60	19.57	19.82	19.42
	120	21.46[b]	22.11[a]	21.22[b]

abc Means with different superscripts in the same raw differed significantly (p<0.05)

Generally agreed phenomenon is that fatty meat lose quality more rapidly than do lean meat. It is widely believed that incorporation of salt in the meat led to increased oxidation. From this point, smoked sample contain less ether extract than other two samples, so the quality of smoking was better than other two drying methods. Ayanwale *et al*. (2007) found that sun dried samples had higher (P<0.05) protein and lower fat than the oven dried meat. The present study was similar to EE content, but sun dried samples contain lower protein value than oven dried meat.

Effects of cooking status

The effects of cooking status on different parameters are shown in Table 3. It is seen that at 30 days the average DM% of cooked and non-cooked meat was 86.9% and 85.38%, respectively. At 30, 60 and 120 days, the maximum DM% was for cooked meat and varied significantly with (P<0.01) with non-cooked meat. At the end (120 days) higher DM loss was observed in non-cooked meat. The initial (30 days) protein value in cooked and non-cooked meat was 76.88% and 74.32%, respectively. The protein value was significantly higher in cooked meat than non-cooked meat. At the end of 120 days, there was also significant difference between cooked and non-cooked meat. The loss of protein was 2.47% and 3.20% for cooked and non-cooked meat, respectively. This variation in loss may be the acidity of meat. Another noticeable effect of cooking meat is the coagulation of proteins. The coagulation and denaturation of the protein is accompanied by shrinkage, increased density and firming of the meat. The collagen of the connective tissue is converted to gelatin to some extent and tenderness may be increased. The results indicate that cooked meat was better than non-cooked meat when their protein content is concerned. The initial value of EE was 3.77% for cooked meat and 4.24% for non-cooked meat. At 120 days the value of EE was 2.64% for cooked meat and 2.99% for non-cooked meat. Ash content increased from 16.15% to 21% at 120 days for cooked meat and 16.80% to 22% at 120 days for cooked meat and 16.80% to 22.00% at 120 days for non-cooked meat.

Table 3. Effects of cooking status on different parameters (g/100 g DM)

Parameter	Periods (days)	Treatment		Significance
		Cooked	Non-cooked	
DM	30	86.9	85.38	NS
	60	85.82	84.02	**
	120	85.02	82.3	**
CP	30	76.88	74.32	**
	60	75.61	72.99	**
	120	74.41	71.12	**
EE	30	3.77	4.24	**
	60	3.23	3.52	*
	120	2.64	2.95	*
Ash	30	16.15	16.8	**
	60	19.09	20.11	**
	120	21	22.2	**

** = Significant at P<0.01; * Significant at P<0.05, NS = Not significant

Effects of meat size

Effects of different sizes of meat on different parameters are shown in Table 4. The initial DM% of Block, Flat and Mince sample was 85.37%, 85.8% and 87.26%, respectively. The DM% gradually decreased with the increase of storage time. At 120 days Mince meat contain significantly (P<0.05) higher amount of DM%. The initial (30 days) protein value in Block, Flat and Mince meat was 76.39%, 77.26% and 73.15%, respectively. At 120 days the Flat meat contain significantly (P<0.01) higher protein %. The initial (30 days) value of EE in Block, Flat and Mince meat was 4.37%, 3.3% and 4.34%, respectively. The EE value gradually decreased with the increase in storage time. At the end of 120 days there was also significant differences (P<0.01) among three samples. Mince meat contain more EE than Block and Flat sample. Ash content of Block, Flat and Mince meat increased from 16.19% to 21.63%, 16.25% to 20.43% and 16.99% to 22.74%, respectively at the end.

Table 4. Effects of meat size on different parameters (g/100 g DM)

Parameter	Periods (days)	Treatment		
		Block	Flat	Mince
DM	30	85.37	85.8	87.26
	60	83.8^{c}	84.83^{b}	86.13^{a}
	120	82.39^{b}	83.71^{ab}	84.89^{a}
CP	30	76.39^{a}	77.26^{a}	73.15^{b}
	60	74.39^{a}	76.13^{a}	72.38^{c}
	120	72.32^{b}	74.36^{a}	71.63^{b}
EE	30	4.37^{a}	3.3^{b}	4.34^{a}
	60	3.57^{a}	2.8^{b}	3.77^{a}
	120	3^{a}	2.21^{b}	3.17^{a}
Ash	30	16.19^{b}	16.25^{b}	16.99^{a}
	60	19.33^{b}	18.67^{b}	20.8^{a}
	120	21.63^{b}	20.43^{c}	22.74^{a}

abc Means with different superscripts in the same raw differed significantly (p<0.05)

The chemical composition of all the samples revealed that DM, CP, EE decreased and ash content increased with increasing storage time. Considering all the parameter studied it may be concluded that flat cooked smoked meat was better considering protein content.

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