

QUALITY OF DRIED MEATS FROM DIFFERENT LIVESTOCK SPECIES

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ABSTRACT

Questions were asked about preference for eating dried meats produced from raw meats of cattle, sheep, goat and camel. Evaluation of consumption liking by colour, flavor, overall desirability and percentage of consumer choice was carried out from 145 panelists who live in Ulaanbaatar. In results, low score in colour, flavor and overall desirability was shown in order for dried meats from cattle, goat, sheep and camel. According this result, consumer choice was high (90%) in dried meat from cattle, while the concentrate (50%) was low in dried meat from camel and sheep. Dried meat from cattle and goat had the lowest TBARS value, followed by mutton and camel meat in that order. In conclusion, dried meat from cattle had the highest scores for the three characteristics and low value in lipid oxidation products.

KEY WORDS: dried meat, lipid oxidation, consumer choice

INTRODUCTION

In Mongolia, dried meat products derived from traditional simple processing continues to hold the large share in local meat production and consumption. This is because, dry meat products are important for nutrition, which essential for nomadic life styles in Mongolia. The dried meat products are commonly prepared by using beef, mutton, goat and camel meat. By the end of December each year, a large number of animals are slaughtered for preparation of dried meat products. Processing of dried meats is based on selection of the raw material, proper slice cutting and drying under natural temperatures and humidity during the coldest months of the year and longtime storage in ambient

temperature. Regarding long time freezing and storage, chemical and structural changes in muscle foods such as lipid oxidation have been reported (Stika *et al.*, 2007). Lipid oxidation is an important factor, which can result in quality losses in meat and meat products. It occurs during processing and storage of meat and meat products and this usually leads to the formation of numerous volatile compounds (Garcia *et al.*, 1991; Flores *et al.*, 1997), such as aldehydes that associated with warmed-over flavor (Tims and Watts, 1958; Pearson *et al.*, 1977). This was previously reported to correlate closely with other negative sensory alterations in meat product, and these included the formation of rancid

odors and off-flavor development (Greene and Cumuze, 1981; Kanner, 1994). In addition, their marked relations to increase the risk of cardiovascular disease, diabetes, cancer and other pathologies in human (Guardiola *et al.*, 1996; Upston *et al.*, 2002) were well noted.

In Mongolia, there is a wide range of meat products produced for domestic market. Nevertheless, it is difficult to assess the quality of products due to the

lack of methodologically based research. There is no published scientific literature available about structural and chemical changes of traditional dried meat products; however, dried meat is normally assessed during long time of consumption.

The current study aimed to examine the quality of 4 kind of dried meat through sensory quality parameters and lipid oxidation, and to provide useful product information to the consumer.

MATERIALS AND METHODS

Determination of consumer liking for type of dried meat

In this study, dried meat products were evaluated by randomly selecting 145 panelists who are citizens of Mongolia and familiar with dried meat products. The panelists were directly asked questions about dried meat products for overall, flavor and colour using 5 point scale without testing : 5- like very much, 4- like slightly, 3- neither like or dislike, 2- dislike slightly and 1- dislike very much. Consumer choice of dried meat from different meat types was also determined.

Samples of dried meat

Four kinds of different meat were purchased from meat market in Ulaanbaatar city and sliced into small pieces.

The pieces were placed on a string of bridge by suspension and dried in a dark room without temperature and humidity control for 3 months during winter and then kept until use.

Proximate analysis

The moisture, protein, fat and ash contents of 4 types dried meat were determined by using the Association of Official Analytical Chemists methods (AOAC).

Moisture content: A 2-3 g of sample was determined by using moisture analyzer (AND MX-50, Japan). Percentage of moisture was determined from the loss in weight.

Protein content: Crude protein was determined by Kjeldahl's method (AOAC-981.10), which was described as follows:

Digestion mixture preparation: The sample (1-1.5 g) was put in digestion flask (Kjeldahl flask) and then digested by heating (420 °C for 130 min) in the presence of sulfuric acid and catalyst.

Dilution: After digestion, the flask was cooled and then digested solution was diluted with distilled water to 100 ml.

Distillation: Diluted solution, saturated NaOH and a little amount of distilled water were put into the distillation tube using a 10 ml pipette. Sulfuric acid

and 2-3 drops of methylen blue-methyl red were added into the receiving flask. The sample was distilled until the solution in the receiving flask became 60 ml.

Titration: The distilled sample was titrated with NaOH solution using a buret. The endpoint of titration is determined by the change in color, from purple to green.

The following equation can be used to determine the nitrogen concentration of a sample that weighs *m* grams using *x*MNaOH solution for the titration.

$$\%N = \frac{x \text{ moles}}{1000\text{cm}^3} \times \frac{(V_s - V_b)\text{cm}^3}{\text{mg}} \times \frac{14 \text{ g}}{\text{moles}} \times 100$$

Where v_s and v_b are the titration volume of the sample and blank and 14 g is the molecular weight of nitrogen N. A blank sample is usually run at the same time as the material being analyzed to take into account any residual nitrogen.

The nitrogen content is converted to a protein content using the appropriate conversion factor:

$$\% \text{ Protein} = F \times \%N$$

Lipid content: Lipid content in dried meat was determined according to Soxhlet extraction method (Association of Official Analytical Chemists 1995).

The thimble with the sample was placed in an extraction chamber, which is suspended above the flask containing solvent and below a condenser.

The flask was heated and the solvent evaporated and moved up into the condenser where it is converted into liquid that trickles into the extraction chamber containing the sample.

At the end of the extraction process (24-48h), the flask containing the solvent was removed, the solvent was evaporated and the mass of lipid remaining was measured (M_{lipid}).

The percentage of lipid in the initial sample (M_{sample}) can then be calculated:

$$\% \text{ Lipid} = 100 \times (M_{\text{lipid}} / M_{\text{sample}})$$

Ash: Ash content was determined by samples in muffle furnace at 525 °C until constant weight. Percentage of ash was calculated in the sample.

Lipid peroxidation assay

Reagents:

Ten percent trichloroacetic acid (10% TCA): I weighed 50g trichloroacetic acid, dissolved it in about 400 ml distilled water and adjusted the volume up to 500 ml with distilled water.

0.02 M thiobarbituric acid (TBA): I dissolved 0.222 g TBA in approximately 200 ml distilled water and then adjusted the volume to 250 ml with distilled water. Protected the solution from light and stored in brown bottle. Standard solution series: A mass of 0.0220 g was dissolved in 100 ml distilled water to prepare stock solution, which was determined to be 0.001 M tetraethoxypropene (TEP, Sigma Chem. Co., ST. Louis. Mo). Standards were prepared as the follows: 0.01, 0.025, 0.05, 0.075 and 0.1 ml of stock were separately added to tubes, which already contained 4.99, 4.975, 4.95, 4.925 and 4.9 ml of distilled water, respectively. A 5ml of distilled water, 10 ml of a 10% TCA and 5 ml 0.02 M TBA were added to the 4 ml of standard series separately before heating in water bath at 100°C for 35 min. Absorbance at 532 nm was recorded and signals of these standard solution series were used to establish a linear calibration line.

Sample preparation: Oxidative stability of dried meats was measured by Thiobarbituric acid reactive substance (TBARS) using the following procedure. Four grams of dried meat was placed in polyethylene stomacher bag. Then 5ml of distilled water, 10 ml of a 10% aqueous solution of

trichloroacetic acid, and 5 ml 0.02 M TBA was immediately added to stomacher bag. Samples were blended for 3 min in stomacher laboratory mixer (Exnizer 400, Organo, Japan). After centrifugation (3500 rpm for 10 min), supernatant was separated through a Toyo filter paper No.5C and then heated in boiling water bath for 35 min to complete the reaction. Intensity of pink colored complex was measured at 532 nm using spectrophotometer. The TBARS values were evaluated using a slope of TEP standard curve and expressed as mg TBARS per kg of dried meat.

Hexanal analysis

A 0.5 g of each dried meat was applied to a glass crimp top vial (10 ml, 24.5 mm o.d., 50 mm height; Supelco Bellefonte, Pa., U.S.A.) and then sealed with both PTFE/ silicone septa (Supelco) and a silver aluminum seal (Supelco). The volatile compounds were extracted by using solid-phase micro extraction technique (SPME) with carboxen/polydimethylsiloxane (CAR/PDMS) as described by Watanabe et al (2008). The hexanal content was separated from volatile compounds in gas chromatograph (GC- MS-QP 2010), following the procedure described by Watanabe et al (2008). Hexanal was identified by comparing its retention time with that from standard compound.

Statistical analysis

Comparison of means among different kinds of dried meat products was performed by ANOVA. All statistical analyses were performed using SPSS 12 package (SPSS Inc., Chicago, USA, 2003)

RESULTS AND DISCUSSION

This study describes the results of sensory quality on scaling method, chemical composition and lipid oxidation in 4 kinds of traditional dried meats. The scores of liking for flavor, colour and overall of each of dried meat are shown in Table 1. Dried meat from cattle had significantly ($p < 0.05$) highest liking scores for flavor, colour and overall than all other dried meat used. In addition, goat liking scores was

significantly ($p < 0.05$) higher than camel and mutton scores. Panelists scored dried meat from dislike very much to like very much, three characteristics of each dried meats had showed a similar scores that ranged from 4.5-4.8, 4.0-4.0, 3.3-3.5, 3.1-3.5, in beef, goat, mutton and camel dried meat, respectively.

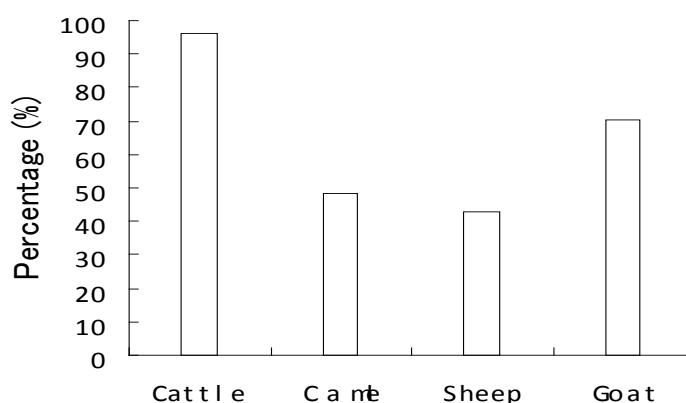
Table 1

Consumer liking for dried meat derived from various animals (Means \pm ST for n=3)			
	Flavor	Colour	Overall
Cattle	4.8 \pm 0.6 ^a	4.5 \pm 0.8 ^a	4.6 \pm 0.5 ^a
Camel	3.4 \pm 1.1 ^c	3.5 \pm 1.1 ^c	3.1 \pm 1.1 ^c
Sheep	3.5 \pm 1.3 ^c	3.5 \pm 1.2 ^c	3.4 \pm 1.2 ^c
Goat	4.0 \pm 1.2 ^b	4.0 \pm 1.1 ^b	4.0 \pm 1.0 ^b

a, b, c Means in the same column with superscript letters in common are significantly different ($p < 0.05$)
5- like very much, 4- like slightly, 3- neither like or dislike, 2- dislike slightly, 1- dislike very much

These results assume that important one or two characteristic in 3 was not in selected dried meat. In Pic.1, percentages of consumer choice were 95.90%, 70.43%, 48.28% and 42.76% from 145 panelists for the cattle, goat, camel and sheep, respectively. Thus indicating that more than one kind of dried meat was consumed by one consumer. Dried meat made from beef and goat were highly consumed than other two. As discussed above, scores on flavor, colour and overall were different between dried meats with the highest scores found in dried beef, and an intermediate score found in dried goat meat. Extremely low scores were obtained in mutton and camel dried meat. A similar trend was found for

percentage of consumer choice. The highest consumption in dried beef than in dried meat from small ruminants can be related to quantitative aspects of livestock production and amounts of meat from carcass weight. Meat production from camel is also high, however, camel numbers are the lowest in livestock numbers [Ministry of Food and Agriculture, 2007 (0.3 camels, 2.2 horses, 2.4 cattle, 17.0 sheep, 18.3 goats, a total of 40.2 millions)] and they are kept only in the south and west of Mongolia. Thus, beef is commonly used in traditional dried meat, therefore higher sensory scores in dried beef than in other types in present study may be dependent on consumer experience.



Picture 1. Consumer choice for 4 types of dried meat

Table 2 shows the moisture, fat, protein and ash contents of different dried meat. Moisture contents of dried meat samples ranged from 9.57% to 14.60%. There were no significant differences in moisture values of different dried meat. The total fat content of dried goat meat was significantly higher ($p < 0.05$)

while protein and ash content were significantly lower ($p < 0.05$) than other dried meats which showed no significant differences. All dried meat had a high fat, protein and ash contents, compared with raw fresh meat.

Table 2

Chemical composition of dried meat from 4 species (% , means \pm ST for n=3)				
	Cattle	Camel	Sheep	Goat
Moisture	10.83 \pm 2.27 ^a	14.60 \pm 5.24 ^a	11.53 \pm 4.12 ^a	9.57 \pm 5.74 ^a
Protein	68.50 \pm 8.35 ^a	70.83 \pm 4.65 ^a	66.07 \pm 5.60 ^a	52.07 \pm 10.17 ^b
Lipid	18.23 \pm 8.26 ^b	12.47 \pm 10.02 ^b	19.00 \pm 3.70 ^b	38.37 \pm 10.77 ^a
Ash	3.43 \pm 0.60 ^a	3.43 \pm 0.25 ^a	3.47 \pm 0.38 ^a	2.47 \pm 0.61 ^b

a, b Means and standard deviation with significantly different ($p < 0.05$)

When meat is sliced and aerobically stored for a long time, lipid oxidation in products increased, reported in previous reports (Gray *et al.*, 1996). In the current study, four types of dried meat had higher TBARS values (Table 3) compared with fresh raw meat in the results reported by Descalzo *et al.* (2005), and also higher than the limited TBARS number reported by Pearson (1968), because processing and long-storage increase the lipid oxidation. In addition, traditionally, five types of livestock namely camels, cattle or yaks, horses, sheep and goats are found in Mongolia where they graze mainly on natural pasture and are not artificially fattened. Therefore, their meat is purely organic in nature and contain high contents of polyunsaturated fatty acid that is susceptible to oxidation (Kanner, 1994) in processed meat product (Drumn and Spainer, 1991) that causes the rapid development of meat rancidity and also affects colour, nutritional quality as well as texture (Kanner, 1994). Enser *et al.* (1998) concluded that polyunsaturated fatty acid content is higher in meat from pasture feeding than those from grain feeding. There were significant differences ($p < 0.05$) in the values of TBARS while in those of hexanal no significant differences between dried meats (Table 3). Standard deviation in results of hexanal in all dried meat was very high, it may be related to muscle type of animal, which is reflected in differences in chemical composition especially fatty acid composition. Hexanal is mainly associated with the

development of lipid oxidation in meat products that contribute to the development of oxidative rancidity known as warmed – over flavor (Dupuy *et al.*, 1987). Among four types of dried meat, the highest TBARS value was in dried meat from camel, the lowest TBARS values were found in both beef and dried goat meat while lipid content was not significantly different except for dried goat meat. Discussion of the differences in dried meats between different species was difficult in this report. This is because TBARS value should be related to the concentration of polyunsaturated fatty acids, natural antioxidants and enzymes (Gatellier *et al.*, 2004; Descalzo *et al.*, 2005), which depend on many factors such as gender, age, production region (Hoffman *et al.*, 2007) and diet (Warren *et al.*, 2008). In this study, observed TBARS values may be due to the difference in fatty acid composition of dried meat from different species. The percentage of PUFA and ratio of linoleic acid metabolites to linolenic acid metabolites (n-6/n-3) in camel meat is higher than those in other meat from domesticated ruminants as reported by Sinclair *et al.* (1982) and Rawdah *et al.* (1994). High levels of PUFA in meat products have previously been associated with high oxidative instability during storage (Ingenet *et al.*, 1980) because their hydrolysis is higher than for monounsaturated and saturated fatty acids. Moreover, Ackman (1990) have shown the existence of positive correlation between deaths by coronary illnesses and high relation of n-6/n-3.

Table 3

Lipid oxidation in dried meat derived from various animals (Means \pm ST for n=3)

Dried meat	TBARS value (mg/kg)	Hexanal value (intensity*)
Cattle	2.96 \pm 0.65 ^c	83.2 \pm 22.3 ^a
Camel	6.15 \pm 0.66 ^a	79.3 \pm 52.6 ^a
Sheep	4.44 \pm 0.43 ^b	242.2 \pm 84.1 ^a
Goat	2.59 \pm 0.31 ^c	233.4 \pm 194.6 ^a

a, b, c Means in the same column with superscript letters in common are significantly different ($p < 0.05$)

*Intensity expressed by peak area relative to that of 105.4 pmol of the 1, 2 dichlorobenzene internal standard

This study observed that dried meat products from different animal species were rich sources of lipid oxidation products. Chronic high ingestion of dried meat product can be a considerable risk to the public health, according to Kanner (2007), who suggested that accumulation of lipid peroxidation products in the body is known to present risks to human health. Lipid oxidation products, especially malondialdehyde (MDA) is one of the most abundant lipid peroxidation cytothoxins, and able to induce changes in blood low-density lipoproteins,

resulting in the formation of atherosclerotic plaques and subsequently, of atherosclerosis and coronary artery disease (Pearson *et al.*, 1983) MDA is also mutagenic and carcinogenic (Basu and Marnett, 1983). According to the health statistics in 2004, cardiovascular diseases and cancer are number one and two, respectively leading causes of human deaths in Mongolia (Ministry of Health, National Center for Health Development, 2004), which are probably associated with a diet low in fruit and vegetable and diet rich in animal fat (Nutrition

Research Center of the Public Health Institute, Ulaanbaatar, 2002). Consumers do not know about the problems that can emerge in the meat production,

such as lipid oxidation products due to lack of information.

CONCLUSION

From the results it can be concluded that traditionally dried meat product from beef had highest panelists score, and lowest TBARS value compared to those from goat, sheep and camel.

Nevertheless, need for extended shelf life and to protect the quality properties of four types of dried meats are urgently needed to augment the existing human health.

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