

# Case study of dietary intake of Amdo Tibetan pastoralists in Huangnan Tibetan Autonomous Prefecture in eastern Qinghai, China

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**Abstract:** The purpose of this paper is to conduct a case study by participant survey for 1) understanding the seasonal dietary intake in summer and winter, and then 2) discussing how current social changes affect dietary intake in the two households of Amdo Tibetan pastoralists in Huangnan Tibetan Autonomous Prefecture in eastern Qinghai, China. It was considered that the spread of freezers and cream separators, and the development of local market economy have reduced the intake of milk products in summer and the intake of meat and internal organs in winter, which led to losing the seasonality of dietary intake of the two households. More cases need to be studied over a wider area to clarify general characteristics of dietary intake among Tibetan pastoralists in Amdo area.

**Keywords:** pastoralism, dietary intake, seasonality, social change

## 1. Introduction

Umesao (1976) proposed the hypothesis that pastoralism, one style of subsistence, was established by the invention of milking and castration. In fact, pastoralists largely depend on milk products which contribute to total energy intake by 64% in Turkana pastoralists (Coughenour *et al.*, 1985), 64% in Masai pastoralists (Galvin, 1992), 45% in Tuareg pastoralists (Benefice, 1984) in Africa, and 8% to 48% in summer in Mongolian pastoralists in North Asia (Ishii, 1998; Hirata, 2012). These cases show that milk products are inevitable ingredients for their living in dry areas. Livestock as living animal will eventually die. If pastoralists do not slaughter livestock and do not eat its meat and internal organs, their laborious efforts to feed livestock are wasted from food resources. Pastoralists in the dry regions of Africa and West Asia do not eat meat in daily meals. They, however, eat meat as special meals when they face festivals and have close friends (Hirata *et al.*, 2017a; Hirata, 2019). Thus, the slaughtering of livestock and eating of its meat and internal organs are incorporated into the dietary habit of pastoralists as special events. In their daily lives, pastoralists do not basically slaughter livestock to obtain foodstuffs but live together with livestock through milking to produce foodstuffs continuously. Here, there is the significance of pastoralism that depends on milk.

Meat and internal organs as well as milk products are

frequently consumed for daily life in the northern region of the Eurasian continent. In the case of Qalqa group of Mongolian pastoralists in central Mongolia, meat and internal organs accounted for 29% to 60% of the total energy intake in winter (Hirata, 2012). Mongolian pastoralists have extremely sparsely subsisted on the vast steppe using for livestock grazing over a radius of 5 km per household. These sparsely using such vast grassland enables a household of Mongolian pastoralists to keep more than hundreds of their livestock. If a household raises 200 ewes and nanny goats, the pregnancy rate is about 100%, and the survival rate of their offspring is 50%<sup>A)</sup>, 100 heads of sheep and goats will be newly self-supplied every year in the household. Such a household can maintain the number of livestock even if they slaughter 8 sheep and goats every month to consume meat and internal organs. Therefore, the presence of vast grassland in North Asia and their use at sparse density enable dependence on the intake of meat and internal organs at a high rate. This contrasts with the Ladakh pastoralists in the northern India who subsist in extremely limited grassland with a high density of population and depend on meat for only 0% to 32% of the total energy intake. The Ladakh pastoralists sometimes consume special meals with meat during festivals and religious events, but not in daily meals (Hirata, 2010). These facts show that the degree of dependence on meat and internal organs changes according to the ecology of the area where the pastoralists subsist. It

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is reported that the vast grassland spreads on the Tibetan Plateau, and the Tibetan pastoralists depend on meat and internal organs in their daily diets (Wang *et al.*, 2010). Thus, the case of Tibetan pastoralists is a very important resource when considering whether the size of the ecological environment and the lower density of land uses direct the dietary intake of pastoralists towards meat and internal organs.

Various policies have been recently implemented to conserve the ecological environment in China. Many Tibetan pastoralists were forcibly moved to local urban sites by the eco-migration policy or the nomadic settlement program (Ptackova, 2012; Gyal, 2015; Bessho, 2015; Si, 2015). The milk processing system of Tibetan pastoralists also changed dramatically due to the introduction of cream separators by the Chinese government in the 1980s (Hirata *et al.*, 2017b). Tibetan pastoralists started to sell livestock and large amounts of milk products in local markets to obtain cash and purchase their necessities from local markets due to the development of market economy and distribution systems in local cities and towns (Yamaguchi, 2011; Han, 2011; Ozaki, 2017). The current situation of Tibetan pastoralists is that their subsistence structure has greatly been affected by these political policies, the market economy and technological innovation.

The purpose of this paper is to conduct a case study by participant survey for 1) understanding the situation of seasonal dietary intake in summer and winter, and then 2) discussing how current social changes affect to dietary intake in the two households of Amdo Tibetan pastoralists in Huangnan Tibetan Autonomous Prefecture in eastern Qinghai, China. Methods of collecting data of a large number of cases by the short questionnaire survey such as 24-hour dietary recall are used to characterize dietary intake in a region as a whole (Willett, 1989). The recording method by participant survey adopted in this paper is not suitable for analyzing the characteristics of the whole region because it is difficult to investigate a large number of cases due to the necessity for a long stay in a household. However, the recording survey is an excellent way to document the details of dietary intake. It is important to record the current situation of Amdo Tibetan pastoralists in detail because of their rapidly changing society. This paper focused on documenting the details of dietary intake and subsistence in two households of Amdo Tibetan pastoralists by conducting a participant survey.

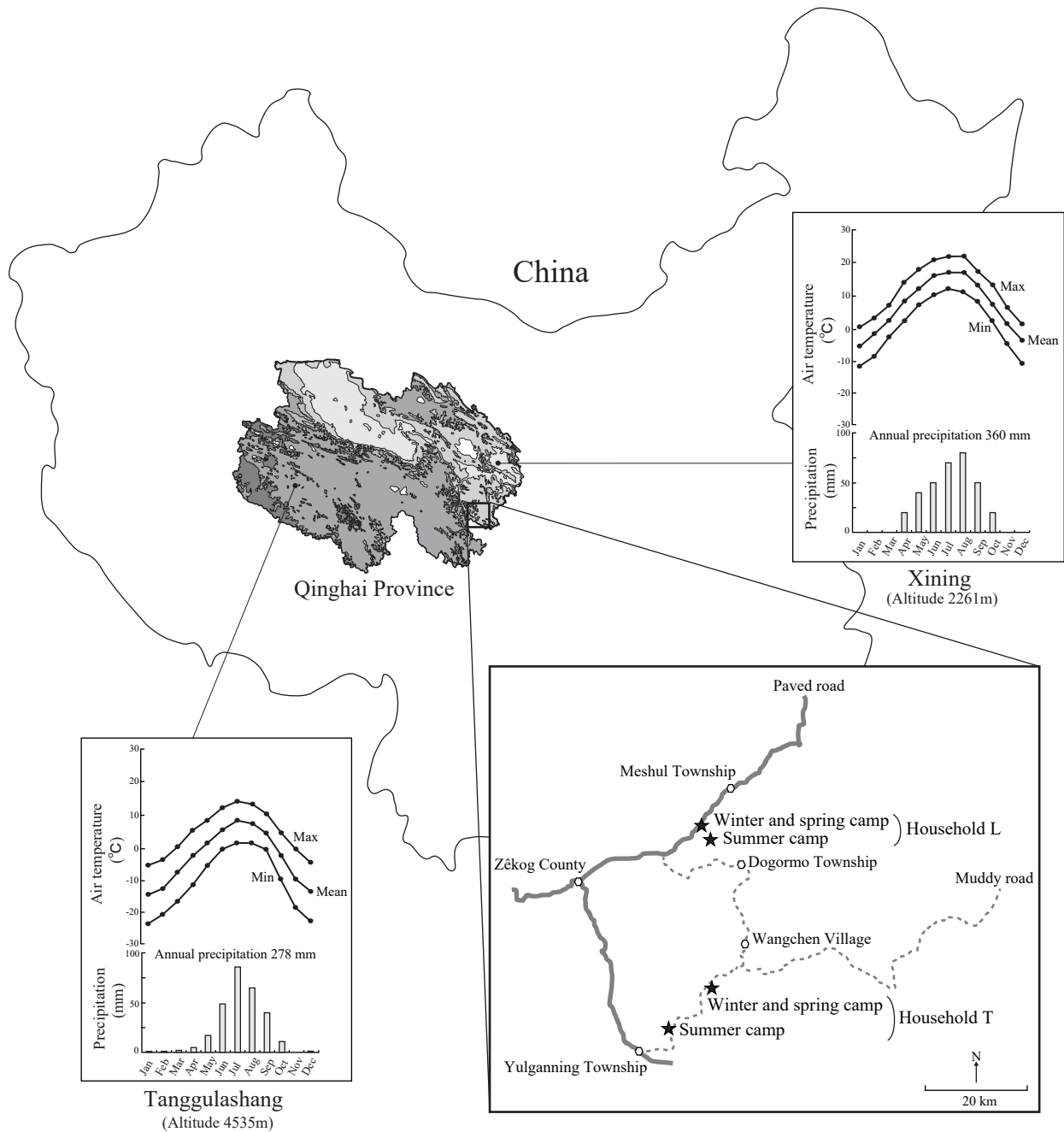
## 2. Study area and method

### 2.1. Survey households

Dietary intake was surveyed in two households of Amdo Tibetan pastoralists (households T and L) during winter from December 23, 2018 to January 2, 2019 and summer from August 7, 2019 to August 17, 2019 (**Figure 1**). Household T camped for raising their livestock in Yulganing Township, Henan County, Huangnan Tibetan Autonomous Prefecture in eastern Qinghai during summer and moved back to a fixed house in Dogormo Township, Zêkog County during winter. Household L stayed within Meshul Township, Zêkog County through the year. Measurement of dietary intake, observations of preparing dishes and interviews of intake habits were conducted in both households. It is said that the majority of pastoralists' households, whose number was 2898 in Meshul Township according to the 2012 statistical survey, had already moved to the settlement due to the Chinese policy by 2014 (Nantaijia and Yamaguchi, 2018). Both the surveyed households continue to move among places seasonally.

Household T consisted of 6 members; husband Ta (51 years old), wife Tb (45), son (24), son's wife (23), and 2 children in the son's family. Household T raised 48 heads of yak, 6 heads of sheep and 1 head of cow in December, 2018. Only yak was milked at present. Sheep and goats were also milked until the end of the Cultural Revolution in the 1970s. Household T used raw milk in their daily diet and also processed it into butter and cheese, without selling raw milk to any markets. In Household L, husband Lu (40) and wife Ls (34) lived together. The wife's parents lived in the center of Meshul Township, and their all 3 children were enrolled in a boarding school in the center of Meshul Township. Household L often shared grazing and consuming food with the wife's uncle household in a nearby neighborhood. Household L kept 75 heads of yak in August, 2018.

The winter camp of household L was about 13 km from the center of Meshul Township, where markets are located. Because there was a paved road between the winter camp of household L and the center of Meshul Township, household L was able to carry raw milk on a motorcycle and sell it to a year-round contractor in the center of Meshul Township. In the area where household T belongs to the Tibetan ethnicity, the market closest to the winter camp of household T was Wangchen Village in Dogormo Township, about 20 km away. Household T could not sell raw milk to the market in Wangchen Village because the distance between the winter



**Fig. 1. Air temperature ( $^{\circ}\text{C}$ ) and contour line (m) of Qinghai, China, and survey households of Amdo Tibetan Pastoralists in Huangnan Tibetan Autonomous Prefecture.**

□ -2000 m   □ 2000-3000 m   □ 3000-4000 m   □ 4000-5000 m   □ 5000-6000 m   □ 6000 m-

camp of household T and the Wangchen Village were rather far away, and muddy road conditions made it difficult to transport liquid milk.

## 2.2. Recording methods for Dietary intake

Dietary intake was measured in the total of 4 persons; husband Ta and his wife Tb in Household T during winter from December 25, 2018 to December 27, 2018, and during summer from August 8, 2019 to August 10, 2019, and husband Lu and his wife Ls in Household L during winter from December 30, 2018 to January 1, 2019, and during

summer from August 12, 2019 to August 14, 2019, respectively. Husband Lu was excluded from the measurement on January 1, 2019 because of staying outside all day and overnight for keeping the livestock in the grassland and on August 14, 2019 because of going out all day. The amounts of consumed foods of husbands and wives in households T and L were measured using a portable scale (AND HL-4000). The amounts of consumed foods were also estimated by visual measurement when they had guests or the meals were not planned in advance. The ingredients used in dishes were also weighed separately to calculate the amount of

food consumed according to the types of ingredients. The calories (kcal), protein (grams), fat (grams), carbohydrates (grams), and ash (grams) of the consumed food in a day were calculated based on the food composition table (Kagawa, 2006).

There are no detailed records of dietary intake before the recent development of market economy and/or the implementation of settlement policies. Hence, interviews were conducted with Jam (70), the father of Ta in household T, and Tse (48) who was a local government employee about the dietary intake around 40 years ago.

### 3. Food items and dietary intake

#### 3.1. Pattern of dietary intake and food items

##### 3.1.1. Winter period

On a dim morning before sunrise, wives in households T and L waked up around 6:30 in winter. The outdoor temperature was around  $-20^{\circ}\text{C}$ . The wives first swept the ashes out of the cooking stove. After cleaning the cooking stove, they put dried yak faces into the cooking stove and light it. A large kettle with plenty of water was on the oven. The wives repeated praying while throwing themselves down and lifting themselves off the ground. The inside temperature was about  $0^{\circ}\text{C}$  and their breath was white. When the husbands and children waked up, the room was already warm. Outside became bright by this time. After praying, the wives washed their faces and hands, and then put a small amount of tea leaves and raw milk in the boiling kettle to make a milk tea named /*hodza*<sup>(B)</sup>. White steam filled the room, signaling the beginning of a day. The wives put water on Buddhist altars, burned butter and roasted barley flour for hungry ghosts on the ground, and sprinkled hot milk tea with a small amount of butter for the sky for devotion to heavenly gods. The husbands offered roasted barley, butter and sandalwood leaves together for devotion to a mountain deity while blowing a conch. After praying to the gods, they began breakfast at around 8 o'clock (**Figure 2**). Breakfast was always tsampa. Tsampa is a meal in which roasted barley flour named /*ni<sup>s</sup>tsam*/, butter named /*mar*/, unmaturing dried cheese named /*te<sup>h</sup>əra*/ and sugar are added to a rice bowl and milk tea is poured into it. Each person kneaded tsampa with the tip of their forefinger and consumed it in a dumpling shape. Sugar was usually added to tsampa because sugar made it tastier. The Amdo Tibetan pastoralists almost always consumed this tsampa with milk tea.

After breakfast, females started milking in the morning. Milking started at around 9:30 in winter. Since yaks were

kept in a barn beside their house during the night, milking was done in the barn. Infant yaks were firstly used to let milk down from the mother yaks by sucking for about 1 minute, and then the mother yaks were milked. Milking under temperatures around  $-15^{\circ}\text{C}$  made their hands cold. Milking all the yaks required about an hour. After milking, males grazed the yaks on grassland. They let the yaks to the targeted grassland for the day, and then the yaks grazed freely during the day. Females collected the yak feces excreted in the barn and spread them on the ground to dry.

After milking, grazing the yaks and collecting feces in the morning, the wives started preparing lunch from about 11:00 without a break. They ate lunch with drinking milk tea. After lunch, they had free time. Each of them had their own way: visiting relatives, chatting with family or drawing water from a stream. When they were thirsty or felt hungry, they drank milk tea and/or consumed baked wheat bread named /*kori*/, sour milk named /*əo*/, tsampa, or lunch leftovers. They usually consumed snacks between meals around 17:00. Consuming snacks in the evening was a custom for the two households. Milk tea and baked wheat bread were often used for snacks.

The wives pulled down water from the Buddhist altar at around 17:00 in the evening. The wives started preparing dinner from around 18:00. The yaks returned from grazing at around 18:30, before dark. The males placed the yaks in the barn and prayed to the mountain god, and then dined together with their families. The outside was already quite dark. During the research period in winter, lunch and dinner were served with boiled meat named /*xa*/ (**Figure 3**), boiled internal organs named /*naŋt<sup>h</sup>ol*/, meat and bean-starch vermicelli soup named /*tjat<sup>h</sup>əg*/ and wheat noodles in meat broth named /*t<sup>h</sup>ent<sup>h</sup>əg*/, steamed meat buns named /*k<sup>h</sup>on*/, sausages named /*tjəma*/, tsampa, baked wheat bread, meat and wheat flour paste named /*ʔeŋog*/, stir-fried potatoes with meat named /*joŋts<sup>h</sup>e*/, steamed Tibetan pizza named /*s<sup>h</sup>oləg*/, milk dishes such as milk noodles and milk porridge named /*fiok<sup>h</sup>o*/ (**Table 1**). Warm dishes were often served for lunch and dinner, and no differences existed between lunch and dinner. Basically, a meal consisted of a single dish with milk tea. Since one yak was slaughtered on December 26, there were a variety of dishes such as boiled meat, boiled internal organs, sausages and steamed meat buns. Brewis and meat soup named /*xak<sup>h</sup>o*/ means the soup dishes which are boiled together with meat or brewis after boiling meat. Therefore, bean-starch vermicelli soup named /*tjat<sup>h</sup>əg*/ and wheat noodles in meat broth named /*t<sup>h</sup>ent<sup>h</sup>əg*/ are also named /*xak<sup>h</sup>o*/. Milk tea was almost always served

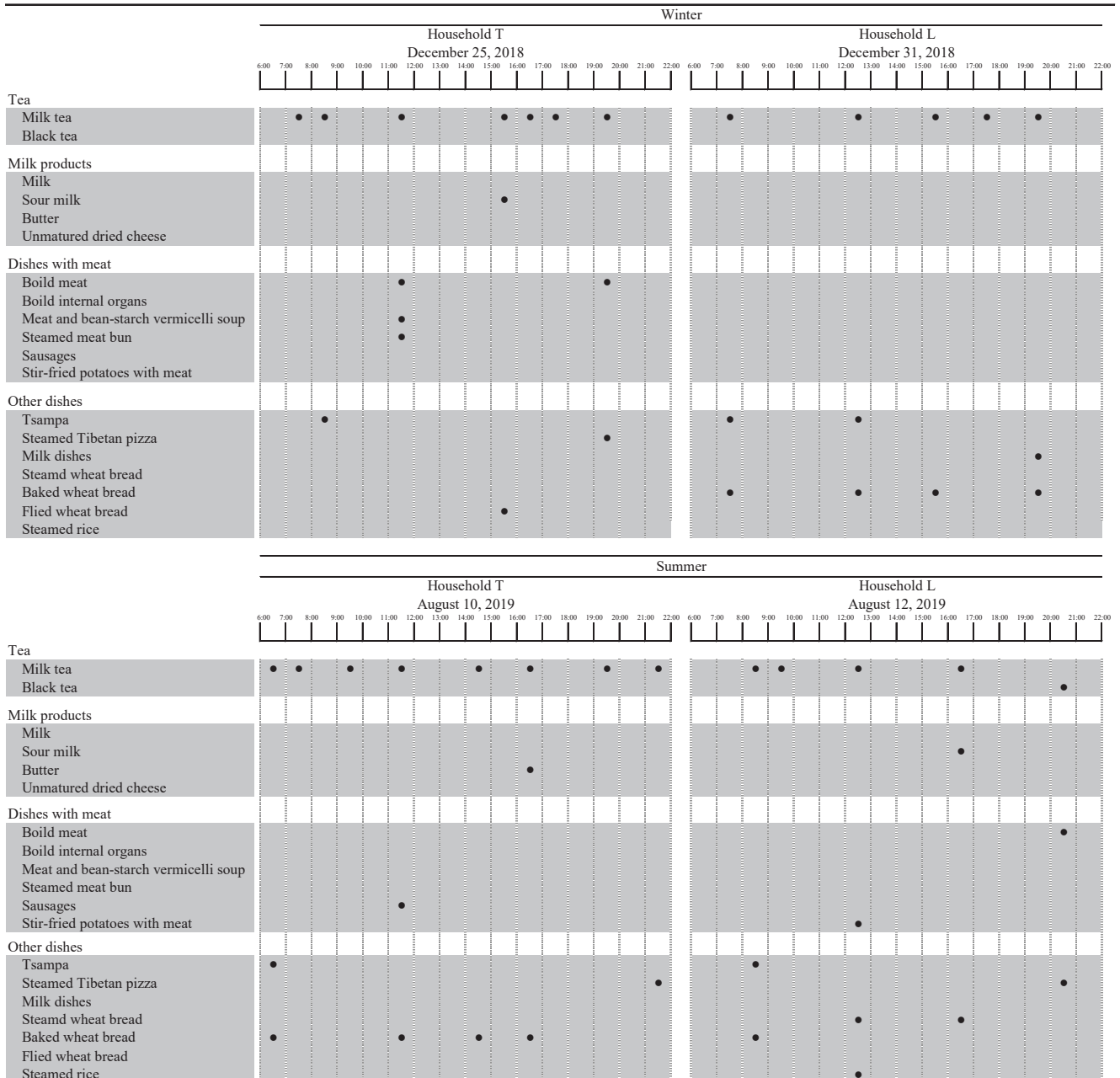


Fig. 2. Dish items and pattern of dietary intake of households T and L during winter and summer.

**Fig. 2. Dish items and pattern of dietary intake of households T and L during winter and summer.**

for breakfast, lunch and dinner. Fig. 2 showed that they frequently drank milk tea throughout the day when they were thirsty or snacking.

Household T and household L did not eat meat and internal organs religiously according to the Tibetan calendar on December 27 and December 31, respectively (Fig. 2). Tibetans are recommended to eat vegetarian food several times a year without meat or internal organs. Vegetarian behavior is recommended on the following days: the 1st, 8th, 10th, 15th, 18th, 21st, 25th and 30th of each month in Tibetan calendar, 16 days from April 7 of Tibetan calendar, memorial days such as the anniversary of the death of

relatives, and the day each one decided. It is said that each person freely decide whether or not to eat meat and internal organs.

Hence, the basic pattern of dietary intake in winter for the two households was tsampa (roasted barley flour and milk products mainly) for breakfast and warm dishes with meat, internal organs and wheat flour for lunch and dinner, almost always with milk tea.

### 3.1.2. Summer period

Summer is the season when wild herbaceous plants are the most abundant in the grassland, and milk yields increase in proportion to the increase in the intake of yaks (Wiener





**Fig. 3.** An Amdo Tibetan pastoralist consumed steamed meat named /xa/ with milk tea.

*et al.*, 2003). The household members moved to a summer camp together and set up temporary tents in grassland to graze yaks. Since days are longer in summer, the days began earlier and they went to bed later at night. They waked up after 6:00. Breakfast was eaten at about 7:00 before milking in household T, while after 8:00 after milking in household L (Fig. 2). Milking required about two hours. Since the milk yield from yaks increased in summer, milking was twice a day in the morning and evening. After milking in the morning, mother and infant yaks were separated and herded for grazing to milk in the evening again. After milking, females collected yak feces, spread them on the ground to dry and drew water from a stream. Lunch was served between 11:00 and 12:00. After consuming snacks around 17:00, milking took place in the evening. Milking in the evening also required about two hours. The sunset and it was dark by the end of milking. Dinner was served at around 21:00.

Tsampa and milk tea were basically served for breakfast. Wife Tb in household T liked baked wheat bread rather than tsampa, and preferred to eat baked wheat bread when she had it. During the research period in summer, lunch and dinner were served with boiled meat, boiled internal organs, meat and bean-starch vermicelli soup, wheat noodles in meat broth, sausages, tsampa, baked wheat bread, meat and wheat flour paste, stir-fried potatoes with meat, steamed Tibetan pizza and milk dishes (Table 1). Both households L and T prepared too much food and also consumed it the next day. When the leftover food was consumed in the next day, it was reheated or dipped in warm milk tea.

Hence, the pattern of dietary intake in summer for the two households was tsampa and/or baked wheat bread for breakfast and warm dishes using meat, internal organs and

wheat flour for lunch and dinner, almost always with milk tea. The same dishes were approximately consumed with similar frequency in both winter and summer.

## 3.2. Dietary intake

### 3.2.1. Winter period

The mean daily caloric intake during winter was 2,757 kcal/day for Ta and 2,550 kcal/day for Tb in household T, and 3,262 kcal/day for Lu and 2,771 kcal/day for Ls in household L, respectively (Table 2). The mean daily caloric requirement per day with a high physical activity level is 3,059 kcal for male aged 30s to 40s, 2,750 kcal for male aged 50s, and 2,300 kcal for female aged 30s to 40s, respectively (Kagawa, 2006)<sup>C</sup>. It was suggested that the daily meal that mainly consisted of milk products, meat and internal organs, and cereals such as barley and wheat provided the required caloric intake for the two households in the condition that the intense labor power was required for milking and grazing management of livestock, and for collecting animal feces.

The mean contribution ratio of caloric intake of milk products, and meat and internal organs to the total caloric intake was 63% for Ta and 50% for Tb in household T, and 46% for Lu and 36% for Ls in household L. Compared with the case of dietary intake in rural areas around Lhasa in the Tibet Autonomous Region where agricultural activities were carried out (Wang *et al.*, 2010), this result in the non-agricultural area of Amdo showed that people were more dependent on milk products and on meat and internal organs. The research area is located in the highland of 3,700 m above sea level, where livestock husbandry is the only production activity. The two households, however, depended for half their volume of dietary intake on purchased foods such as barley flour, wheat flour and sugar. The two households who subsist in the highland with their livestock largely depended on crop production from cultivated areas below 3,000 m altitude. Moreover, the younger household L increased more their dependence on dietary intake even more for the agricultural food produced in the cultivated area.

The intake of milk products, and meat and internal organs contributed to 53% to 81% of total protein intake and 76% to 96% of total fat intake, respectively. Milk products, and meat and internal organs are indispensable foods for the two households. The daily protein allowance<sup>C</sup> is 60 g/day for male in their 30s to 50s, and 50 g/day for female in their 40s (Kagawa, 2006). The mean daily protein intake was 77 to 119 g/day in households T and L. The two house-

**Table 1. Contents of breakfast, lunch, and dinner of households T and L during winter and summer.**

Winter									
Month, day	Household T				Month, day	Household L			
	Breakfast	Lunch	Snack	Dinner		Breakfast	Lunch	Snack	Dinner
December 25	Tsampa	Meat and bean-starch vermicell soup Boiled meat Steamed meat bun Milk tea	Sour milk	Steamed Tibetan pizza Boiled meat Milk tea	December 30	Tsampa	Wheat flour paste Milk tea	Baked wheat bread	Steamed meat bun Milk tea
	Milk tea		Sugar					Milk tea	
			Baked wheat bread						
			Milk tea						
December 26	Tsampa	Boiled meat Sausages Boiled internal organs Milk tea	Milk tea	Steamed meat bun Boiled meat Sausages Baked wheat bread Milk tea	December 31	Tsampa	Tsampa Baked wheat bread Milk tea	Baked wheat bread	Milk dish Baked wheat bread Milk tea
	Milk tea								
December 27	Tsampa	Tsampa Baked wheat bread Fried wheat bread Milk tea	Baked wheat bread	Wheat noodles in meat	January 1	Tsampa	Stir-fried potatoes with meat Baked wheat bread Black tea	Milk tea	Steamed meat bun Milk tea
	Milk tea								
Summer									
Month, day	Household T				Month, day	Household L			
	Breakfast	Lunch	Snack	Dinner		Breakfast	Lunch	Snack	Dinner
August 8	Tsampa	Boiled meat Meat and bean-starch vermicell soup Milk tea	Baked wheat bread	Meat wheat noodles Baked wheat bread Milk tea	August 12	Tsampa	Steamed wheat bread Butter Sugar Steamed rice Stir-fried potatoes with meat Milk tea	Baked wheat bread	Steamed Tibetan pizza Butter Milk tea
	Baked wheat bread		Milk tea						
	Milk tea								
August 9	Tsampa	Sour milk Baked wheat bread Milk tea	Baked wheat bread	Sausages Milk tea	August 13	Tsampa	Steamed Tibetan pizza Black tea	Tsampa	Steamed Tibetan pizza Butter Milk tea
	Baked wheat bread		Milk tea						
	Milk tea								
August 10	Tsampa	Sausages Baked wheat bread Milk tea	Baked wheat bread	Steamed Tibetan pizza Milk tea	August 14	Tsampa	Stir-fried potatoes with meat Meat and bean-starch vermicell soup Milk tea	Sour milk	Milk dish Black tea bean-starch vermicell soup Sugar Milk tea
	Baked wheat bread		Milk tea						
	Milk tea								

holds met the recommended protein intake by foods mainly supplied from milk products, and meat and internal organs. However, the recommended daily fat intake<sup>(c)</sup> is 20% to 25% of total caloric intake for both male and female in their 30s and 50s (Kagawa, 2006). In the case of the two house-

holds, this value corresponds to 59 to 73 g/day for Ta, 54 to 68 g/day for Tb, 69 to 87 g/day for Lu, and 59 to 74 g/day for Ls, respectively. Fat intake in each case was about 100 g/day only from milk products, and meat and internal organs, which resulted in excessive fat intake. Excessive fat

**Table 2. Mean dietary intake per day of husband Ta and his wife Tb in household T and husband Lu and his wife Ls in household L during winter and summer.**

Winter										
Intake item	Ta					Tb				
	Energy	Protein	Fat	Carbohydrate	Ash	Energy	Protein	Fat	Carbohydrate	Ash
	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)
Total diet intake	2757 (100)	119 (100)	140 (100)	240 (100)	13 (100)	2550 (100)	77 (100)	112 (100)	271 (100)	10 (100)
Self-supplied food	1732 (63)	97 (81)	134 (96)	23 (10)	8 (62)	1275 (50)	53 (68)	106 (94)	23 (8)	6 (60)
Purchased food	1025 (37)	22 (19)	6 (4)	217 (90)	5 (38)	1275 (50)	24 (32)	6 (6)	249 (92)	4 (40)
Meat and internal organs	918 (33)	66 (56)	67 (48)	2 (1)	4 (28)	324 (13)	20 (26)	25 (23)	0 (0)	1 (10)
Milk products	814 (30)	30 (26)	67 (48)	21 (9)	5 (35)	951 (37)	33 (42)	80 (72)	22 (8)	5 (49)
Barley	403 (15)	9 (8)	3 (2)	74 (31)	2 (15)	454 (18)	12 (15)	4 (3)	94 (35)	3 (26)
Wheat	439 (16)	12 (10)	2 (2)	88 (36)	1 (5)	527 (21)	11 (14)	2 (2)	84 (31)	1 (6)
Vegetables	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.0 (0)	0 (0)
Intake item	Lu					Ls				
	Energy	Protein	Fat	Carbohydrate	Ash	Energy	Protein	Fat	Carbohydrate	Ash
	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)
Total diet intake	3262 (100)	107 (100)	127 (100)	401 (100)	18 (100)	2771 (100)	87 (100)	103 (100)	357 (100)	15 (100)
Self-supplied food	1502 (46)	65 (61)	117 (92)	38 (9)	6 (33)	994 (36)	46 (53)	78 (76)	19 (5)	4 (28)
Purchased food	1760 (54)	42 (39)	10 (8)	363 (91)	12 (67)	1777 (64)	41 (47)	24 (24)	337 (95)	11 (72)
Meat and internal organs	787 (24)	31 (29)	69 (55)	0.5 (0)	2 (8)	499 (18)	11 (24)	43 (42)	0 (0)	1 (7)
Milk products	650 (20)	33 (31)	47 (37)	21 (5)	5 (25)	474 (17)	33 (29)	35 (34)	14 (4)	3 (21)
Barley	348 (11)	9 (8)	3 (2)	72 (18)	2 (11)	309 (11)	9 (9)	2 (2)	64 (18)	2 (12)
Wheat	1230 (38)	32 (30)	7 (6)	246 (61)	2 (9)	1151 (42)	27 (29)	7 (6)	230 (64)	2 (11)
Vegetables	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	80 (3)	1 (1)	0 (0)	18 (5)	1 (8)
Summer										
Intake item	Ta					Tb				
	Energy	Protein	Fat	Carbohydrate	Ash	Energy	Protein	Fat	Carbohydrate	Ash
	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)
Total diet intake	3972 (100)	142 (100)	154 (100)	473 (100)	21 (100)	2598 (100)	103 (100)	94 (100)	313 (100)	14 (100)
Self-supplied food	1767 (44)	87 (61)	142 (92)	24 (5)	8 (39)	1159 (45)	67 (65)	87 (92)	20 (6)	7 (48)
Purchased food	2205 (56)	55 (39)	13 (8)	449 (95)	13 (61)	1439 (55)	36 (35)	8 (8)	293 (94)	7 (52)
Meat and internal organs	920 (23)	55 (39)	73 (47)	1 (0)	3 (15)	633 (24)	43 (41)	48 (51)	1 (0)	3 (19)
Milk products	847 (21)	32 (23)	69 (45)	23 (5)	5 (23)	526 (20)	25 (24)	39 (41)	20 (6)	4 (28)
Barley	303 (8)	7 (5)	2 (1)	55 (12)	2 (7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Wheat	1782 (45)	47 (33)	10 (7)	356 (75)	2 (12)	1341 (52)	35 (34)	8 (8)	268 (86)	2 (13)
Vegetables	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Intake item	Lu					Ls				
	Energy	Protein	Fat	Carbohydrate	Ash	Energy	Protein	Fat	Carbohydrate	Ash
	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)	kcal/day (%)	g/day (%)	g/day (%)	g/day (%)	g/day (%)
Total diet intake	2519 (100)	73 (100)	97 (100)	320 (100)	14 (100)	3295 (100)	95 (100)	126 (100)	423 (100)	18 (100)
Self-supplied food	1011 (40)	37 (51)	89 (91)	9 (3)	3 (25)	1299 (39)	51 (54)	111 (89)	15 (4)	5 (30)
Purchased food	1507 (60)	36 (49)	9 (9)	311 (97)	10 (75)	1996 (61)	44 (46)	14 (11)	408 (96)	13 (70)
Meat and internal organs	443 (18)	21 (28)	38 (39)	0 (0)	1 (7)	493 (15)	25 (26)	41 (33)	0 (0)	1 (7)
Milk products	568 (23)	17 (23)	51 (53)	9 (3)	2 (18)	807 (24)	26 (28)	70 (56)	15 (4)	4 (23)
Barley	377 (15)	10 (13)	3 (3)	78 (24)	2 (15)	329 (10)	11 (12)	3 (2)	68 (16)	2 (10)
Wheat	985 (39)	26 (36)	6 (6)	197 (61)	1 (10)	1036 (31)	38 (40)	6 (5)	207 (49)	3 (17)
Vegetables	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	25 (1)	0 (0)	0 (0)	6 (1)	0 (2)



intake may lead to adult diseases (Sherpa *et al.*, 2010). This suggested for the dietary habitat of the two households that their dietary intake, which mainly depended on milk products, and meat and internal organs, was extremely important in the supply of calories and protein but oversupplied in fat.

### 3.2.2. Summer period

The mean caloric intake in summer was almost the same as in winter (Table 2). The mean contribution ratio of caloric intake of milk products, and meat and internal organs to the total caloric intake was 44% for Ta and 45% for Tb in household T, and 40% for Lu and 39% for Ls in household L, respectively. The dependence on self-sufficient food in summer tended to decrease compared with winter. This result came from more consumption of baked wheat bread. The caloric dependence on wheat was 45% (16% in winter) for Ta, 52% (21%) for Tb in household T, and 39% (38%) for Lu and 31% (42%) for Ls in household L. The caloric intake of Ta in household T was 3,972 kcal/day, which was a significant increase compared to winter (2,757 kcal/day), because of the large intake of baked wheat bread. Wife Tb in household T preferred baked wheat bread rather than tsampa using barley and consumed baked wheat bread from the morning when it was available, which led the caloric intake of wheat to the half of the total caloric intake. It was indicated that the current dietary habitat of the two households depended on wheat more than barley throughout the year.

The mean contribution ratio of caloric intake of milk products to the total caloric intake in summer was 21% for Ta and 20% for Tb in household T, and 23% for Lu and 24% for Ls in household L, respectively. Although milk production of yak increases in summer and the amount of milking is the highest in the year, the caloric intake of milk products was almost the same in summer and winter. The fact that caloric intake of milk products did not change significantly between summer and winter also showed a similar tendency in intake of meat and internal organs. The contents of dietary intake of the two households at the present did not change significantly with the seasons.

The contribution ratios of milk products, and meat and internal organs were 51% to 65% in the total protein intake, and 89% to 92% in the total fat intake, which were also high values as was in winter. It was also confirmed in summer that the intake of milk products, meat and internal organs provided most of the necessary proteins, and fat intake was excessive for the two households.

## 4. Current changes in dietary intake

The results of this case study in the two households showed that the contribution ratio of caloric intake of milk products to the total caloric intake was 17% to 37% in winter and 20% to 24% in summer, respectively. Its value of meat and internal organs was 13% to 33% in winter and 15% to 24% in summer, respectively. These results of the two households demonstrated that the dietary intake of milk products, and meat and internal organs did not change according to the season. Based on the testimony of Jam, who is the father of Ta, and Jan, who is a relative of Ta, Amdo Tibetan pastoralists had consumed more milk products in summer and more meat and internal organs in winter 40 years ago. Hence, their dietary habits of the two households in recent years have been less seasonal and changed to consume almost the same food throughout the year. Why are the two households no longer consuming more milk products in summer and more meat and internal organs in winter?

In household T, boiled meat chunks, boiled internal organs and sausage were consumed throughout the year. Those foods were often consumed especially during winter in the past. This tendency was due to the livestock management of livestock and foodstuff utilization, in which a few yaks were slaughtered in the early winter, and those meat and internal organs were frozen and preserved using a natural temperature of about  $-20^{\circ}\text{C}$  and consumed during winter (Nantaijia, 2018). According to Jam, since meat and internal organs naturally frozen in early winter melt and spoiled in April of the Tibetan calendar, those had been consumed by April. At present, electric freezers are widely spreading in Amdo Tibetan pastoral society. Meat chunks and internal organs are stored in small portions in freezers, and only the necessary amount is removed from the freezer when they need. These can be consumed frequently even in summer. Due to the spread of freezers, there is no need to consume all frozen meat and internal organs during winter when the temperatures are below zero. It has become possible to keep them frozen after April and consume them throughout the year. It was considered that the spread of freezers was one of the main reasons for the reduction of the seasonality of dietary intake of the two households.

Consumption of milk products was about 20% in summer and similar in winter. According to the testimony of Tse, raw milk had been processed into sour milk every day during summer when milk production was relatively high in a year, sour milk had been consumed several times a day

and churned to produce butter. Sour milk was currently consumed only once every few days (Table 1, Fig. 2). It was suggested that the decreased intake of sour milk has reduced the consumption of milk products in summer.

One of the characteristics of the milk processing system of Amdo Tibetan pastoralists is that they had adopted the technology of fermentation processes transmitted from West Asia (Hirata *et al.*, 2015; Hirata *et al.*, 2017b). The fermentation process means that fermentation is the first stage of processing milk, fermented milk is further processed to butter by churning, and buttermilk is processed into cheese by heating, draining and sun-drying (Nakao, 1972). The milk processing system of Amdo Tibetan pastoralists has significantly changed in recent years due to the introduction of cream separators by the Chinese government in the 1980s. They stopped processing sour milk for butter processing by churning, and alternatively started to separate cream from raw milk, using a cream separator, and process cream into butter by hand mixing. Cream separators have rapidly spread in Amdo Tibetan communities and all households are currently using them because the utilizing of a cream separator make time for churning cream to butter drastically shorter than sour milk to butter. The subsistence strategy is chosen to maximize energy gain relative to energy input (Kuchikura, 1995). Hence, due to the spread of cream separators, sour milk was no longer processed every day.

Furthermore, recent development of the local market economy was considered to be an important factor that has reduced the intake of milk products. In recent years, Amdo Tibetan pastoralists sell as much butter and unmaturing dried cheese in the market as possible to earn more cash. Jam said that raw milk was less frequently used for preparing dishes, but more for processing cream, butter, and cheese at the present. Jam also indicated that the selling of butter and cheese in a local market has reduced the frequency and amount of self-consumption of milk products, and also has reduced the opportunity to process raw milk into sour milk. Therefore, the spread of cream separators and the development of the local market economy have reduced the frequency and amount of using raw milk for cooking and self-consumption of sour milk in the two households.

In the case of Dondo-Govi Province in central Mongolia, the dependence of the Qalqa group of Mongolian pastoralists on milk products was 8% to 24% in the total caloric intake during the milking period in summer and 0% to 8% during the non-milking period in winter (Hirata, 2012). There was the seasonality of intake of milk products for the Mongolian pastoralists. Freezers and cream separators were

not widespread in Mongolian pastoral societies and almost no milk products were sold at markets in the surveyed area. Most of milk products were consumed within households. They consumed more milk products in summer when the milking amount increased. Mongolian pastoralists also had the intake habit of drinking alcoholic fermented mare milk from morning to evening in summer. Their preference for drinking large amounts of alcoholic fermented mare milk increased their dependence on milk products in summer. It was considered in the case of Mongolian pastoralists that most of milk products were consumed in households without being sold at markets, which meant that the intake of milk products increased in summer and that dietary intake changed seasonally.

Thus, it was considered that the spread of freezers and cream separators, and the development of local market economy have reduced the intake of milk products in summer and reduced the intake of meat and internal organs in winter, which led to eliminating the seasonality of dietary intake of the two households of Amdo Tibetan pastoralists. More cases need to be studied over a wider area to clarify general characteristics of dietary intake among Amdo Tibetan pastoralists in the Amdo area.

## 5. Conclusion

The pattern of dietary intake for the two households of Amdo Tibetan pastoralists was tsampa and/or baked wheat bread for breakfast and warm dishes using meat, internal organs and wheat flour for lunch and dinner, almost always with milk tea. The mean contribution ratio of caloric intake of meat and internal organs to the total caloric intake was 15% to 33% in the two households, and they depended on the availability of meat and internal organs throughout the year. It was suggested in the case of two households that the ecological factor of vast grasslands and their use at sparse density directed the dietary intake of pastoralists towards meat and internal organs also in Amdo, Tibetan Plateau.

The results of this case study in the two households indicated that the caloric intake of meat and internal organs was 324-918 kcal/day in winter and 443-920 kcal/day in summer, respectively. The value for milk products was 474-951 kcal/day in winter and 526-847 kcal/day in summer, respectively. The dietary intake of the two households did not change according to the season, and its frequency and the amount were almost the same throughout the year. Based on the interview research, it appeared that the spread of freezers and cream separators and the development of local market economy have reduced the intake of milk products

in summer and the intake of meat and internal organs in winter, which led to eliminating the seasonality of dietary intake of the two households.

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## Note

- A) In the case of the Qalqa group of Mongolian pastoralists in central Mongolia surveyed by one of the authors (Hirata, 2012), the pregnancy rate of ewes and nanny goats was about 100%. Even after deducting the loss due to the death of the offspring, it is quite possible that the survival rate of the offspring will be over 50%.
- B) The rule of Phonological transcription followed “Dictionary of Tibetan Pastoralism” (Team NomaDic, 2018) (<https://nomadic.a-a-ken.jp/search/>).
- C) These values are based on the Japanese nutritional standards (Kagawa, 2006).

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# 中国青海省東部の黄南藏族自治州における アムド・チベット牧畜民の食料摂取の事例研究

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**要旨：**本稿の目的は、アムド・チベット牧畜民2世帯について、1) 夏期と冬期の食料摂取の季節変化を把握し、2) 近年の社会環境の変化が牧畜民の食生活にどのような影響を与えているかを、参与型調査により事例研究することにある。アムド・チベット牧畜民2世帯の食料摂取は、近年の冷凍庫とセパレーターの普及、市場経済の浸透により、夏期に乳・乳製品への摂取量が低下し、冬期に肉・内臓の摂取量が抑えられることにより、アムド・チベット牧畜民の食料摂取が季節性を失ってきたことが示唆された。

**キーワード：**牧畜，食料摂取，季節性，社会変化

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