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Bamboos for food: Nepalese perspective

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Abstract

Bamboo shoot is one of the important food items in Nepal especially for the *Newar* ethnic group. They have to have one item known as *Aalu Taama* (in the Nepali language), a spicy vegetable prepared with the combination of fermented bamboo shoots (*Taama*) with Potato (*Aalu*) and black-eye beans (*Bodi*) during their ceremonial feast. Bamboo shoots are consumed in three forms: fresh shoots, fermented and dried fermented. Of the various types of bamboo Nepalese prefer shoots of *Dendrocalamus hamiltonii* (*Taama bans*) and *Bambusa nepalensis* (*Taama bans*) as food item. The fermentation is allowed for 10 -15 days, 1-2 to 3 months depending on the market demand and is reciprocated its sourness. The other type of shoots, known as *Tusa* (in the Nepali language), which comes from small size bamboo like *Drepanostachyum* species, are consumed fresh. In all fresh bamboo shoots the moisture content is high (more than 94%) whereas the moisture content in the dried bamboo shoot is only 10.85%. The carbohydrate percent is very high (41.77 %) in the dried fermented bamboo shoot. It has several health benefits such as prevention of cardiovascular diseases, cancer, diabetic and hyper-tension. The most predominant anti-nutrient in bamboo shoots is cyanogenic glycosides which ranges from 36.32 to more than 1000 mg/ kg. Fermentation is the best method for reducing the anti-nutrient content and improving the quality of bamboo shoots. All three types of *Taama* and *Tusa* are available in the market. The price varies as per their freshness, fermented category and their availability. The fresh shoots are available at a local market at a rate of US \$ 1.5 per kilogram (kg). The fermented bamboo shoot is costly (US \$ 1.5-2.0 per kg) in comparison to the fresh one whereas the fermented and dried one is more expensive than the others (US \$ 4.0-5.0 per kg)). Because of their nutritional properties and its distribution throughout Nepal, it has potential for being future health food.

Keywords Bamboo shoot; Nutritional food value; Value addition; Nepal.

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1. Bamboo Shoots as a Food Item

Bamboo shoot is one of the important food items in Nepal. Most Nepalese people do consume bamboo shoots in their daily life and in feast. It is one of the important food items for Nepalese, especially for the *Newar* ethnic group. They have to have one item known as *Aalu Taama* (in the Nepali language), a spicy vegetable prepared with the combination of fermented bamboo shoots (*Taama*) with Potato (*Aalu*) and black-eye beans (*Bodi*) during their ceremonial feast (Figure 1) since time immemorial. Older generation must have had some idea of benefits of using bamboo shoots in their diet but they were not in a position to provide hard facts and figures. However, at present date, some studies suggest that bamboo shoots help reduce cholesterol level. Dahal *et al* (2005) have also referred *aalu- tama-bodi* (potato-mesu-white beans) is one of the popular food item in Newar community in Nepal. It is served in a hot soup base, which is scrumptious and sour. The *Aalu Taama* is Nepalese cuisine and it goes with rice during lunch and dinner. The bamboo-based foods are increasingly getting importance for all Nepalese, irrespective of ethnicity, and to foreigners. Hotels and restaurants serve bamboo-based vegetables in Nepal.



Figure 1. *Aalu Taama bodi* Nepalese cuisine (Photo credit: Giridhar Amatya, 2023)

Nepalese people consume bamboo shoots in three forms: fresh shoots as vegetables in gravy form, soup-based vegetables, and pickles made of fermented shoots as major food ingredients. But a little is known about their preparation process and its nutritional value. Khadka and Lama (2020) have covered elaborately on the history of fermentation and fermented food of Nepal. They have discussed the nutritional and nutraceutical potential of almost all types of food items used in Nepal, however, the chemical compositions of bamboo shoots are lacking. Hence an attempt has been carried out to look at these aspects of bamboo shoots.

2. Objectives

The main objective is to document the traditional knowledge of preparing food items from bamboo species and examine their nutritional values.

3. Species Preference for Food

Taama is prepared from varieties of bamboo but most Nepalese prefer to have bamboo shoots from *Dendrocalamus hamiltonii* (*Taama bans*) and *Bambusa nepalensis* (*Taama bans*). *Dendrocalamus hamiltonii* (*Taama bans*) species is found between 300 to 2000 m whereas *Bambusa nepalensis* (*Mal bans*) has some restricted availability between 500-1500 m (TIS 2004). Nonetheless, the product obtained from these bamboo species are known as *Taama* irrespective of their product types (fresh, dry and preserved one).

4. Food forms

Taama from fresh shoots

Nepalese people consume *taama* in three forms. The first one is from fresh shoots. Normally they are obtained from the shoots of *Dendrocalamus hamiltonii* (*Taama bans*) and *Bambusa nepalensis*. (*Mal bans*). Other types of bamboo varieties that are used as *taama* vegetables have been recorded by Dahal *et al* (2005) are *bhalu bans* (*Dendrocalamus sikkimensis*), *Dhungre bans* (*Dendrocalamus giganteus* and *Karati bans* (*Bambusa tulda*). The young shoots of these bamboos, are cut from bamboo clumps when they reach a height of about 18 - 20 cm, during the month of July-August (Figure 2). They are stripped off from their sheath and made clean (Figure 3 and 4). They are cut into pieces as per the food habit and convenience (Figure 5)



Figure 2. Young bamboo shoot ready for harvesting, Hetauda, Makwanpur district, 345 m. (Photo courtesy: Nar Bahadur Rai)



Figure 3. Harvested fresh bamboo shoots (Photo courtesy: Giridhar Amatya, 2023)



Figure 4. Clean bamboo shoots (Photo courtesy: Nar Bahadur Rai, 2023)



Figure 5. Bamboo shoots cut for fresh food and for the fermentation process (Photo courtesy: Giridhar Amatya 2023)

It has been experienced that lower portion (hard part of the shoot) of fresh bamboo shoots have some bitterness in its taste. Although it has not been yet proved but fresh bamboo shoots must have some toxic elements. It is for this reason fresh shoots are boiled to make it soft before they are used as food.

***Tusa* from fresh shoots**

The other type of shoot, known as *Tusa* (in the Nepali language), comes from small size bamboos like *Drepanostachyum* species (Figures 6 and 7). They are small-sized bamboo and are collectively known as *Nigale tusa*. They grow well over 2000 m in a forest canopy and are harvested in the month of July-August and are consumed only as fresh vegetables. Unlike others, *tusa* are not fermented. They are consumed fresh. The tender fresh shoots of small bamboos are consumed as stir-fried or thick broth curry. *Arundinaria racemosa* produces one of the best shoots to eat. The shoots of *Drepanostachyum intermedium* are available in the vegetable markets in Kathmandu and they are sold on the weekly markets in many hill towns of Nepal (Poudyal, 2006).



Figures 6. Fresh *Nigaalo Tusa* (*Drepanostachyum* sp. Lele, Lalitpur Nepal) ready for sale (Photo courtesy: Giridhar Amatya, 2023)



Figure 7. Fresh *Nigaalo Tusa* (*Drepanostachyum* sp. Lele, Lalitpur Nepal) ready for cooking (Photo courtesy: Giridhar Amatya, 2023)

5. Fermentation process of young bamboo shoots

It is common practice in Nepal to preserve seasonal vegetables in dry form for use in the off-season. Bamboo shoot is also included in this category. Ethnic differences, however, affect household consumption patterns. As cited by Khadka and Lama (2020), approximately 91 foods and its derivatives are consumed in wet and dried or wet fermented forms with its unique way of preparation in Nepal. The freshly harvested bamboo shoots are preserved through the fermentation process—so that they are available throughout the year. The edible portions are chopped into desirable sizes of small pieces and to enhance the fermentation and the chopped shoots are boiled until they become soft and tender. The prepared shoots are firmly packed in the previously dug pit in the earth. The size of pit depends on the quantity of shoots to be fermented. The pit is sterilized by burning the dried leaves and lined firmly by the leaves of *Bhorlaa* (*Bauhinia vahlii*) or banana leaves as per their availability. The pit is filled with cut pieces of bamboo shoots and the pit's open part is sealed tightly. The fermentation is allowed for 10 -15 days, 1-2 months, and sometimes up to 3 months depending on the market demand. The fermentation period is reciprocated by the sourness of the bamboo shoots. The fermented shoots are packed in a suitable container (mostly a thick plastic bag) (Figure 8).



Figure 8. Fermented bamboo shoots packed in the polythene bag for sale (Photo courtesy: Swoyambhu Man Amatya, 2023)



Figure 9. Fermented bamboo shoot (*Taama*) in loose for bulk sales (Photo courtesy: Giridhar Amatya, 2023)

At the household level, fermented bamboo shoots (*Mesu/Taama*) are further garnished with Turmeric powder and edible oil (preferably Mustard oil) to enhance the shelf-life period and packed firmly in a suitable container and used as pickle and vegetables.

6. Fermented Dried Shoots

Some of the fermented stuff are dried in sun light till they are drained off all moisture. Sometimes it takes a week to dry them completely. These stuffs are also known as dried *Taama* (*Sukeko Taama in Nepali language*) (Figure 10). They are sourer in taste.



Figure 10. Dried bamboo shoots (Photo courtesy: Giridhar Amatya 2023)

7. Physical and chemical composition of *Taama and Tusa*

Tamang and Sarkar in 1996 have reported some chemical analysis of Mesu bamboo. They have indicated possible benefits from bamboo shoots including increase in digestion and its function as appetizer. However, the chemical composition has not yet been assessed for *Taama* and *Tusa*, and the dried *taama* as well. Hence, samples of edible fresh bamboo shoots of *Dendrocalamus hamiltonii* (*Taama Bans*) were collected from Sindhupalchok (above 850 m), Kavrepalanchok district (above 1007 m) and Chitwan district (450 m) of Nepal. Fermented and dried shoots of this species were also collected from Lalitpur district (1350 m). Additionally, fresh shoots of small variety of *Drepanostachyum* sp. (*Nigale Tusa*) were also collected from Lele, Lalitpur (1350 m) district of Nepal. The physical characteristics of these samples were recorded. All the samples were analyzed at the Department of Food Technology and Quality Control (DFTQC), Government of Nepal in the month of August 2023. DFTQC mainly analyzed the moisture, carbohydrate, crude protein, fat, total ash, crude fiber, energy value and acidity following the Kjeldahl's method. A factor of 6.25 has been used to convert total nitrogen into protein.

Physical characteristics

It has been found that although there are some variations in the physical characteristics of the collected bamboo shoots (colour, aroma, texture) of both big and small bamboo, all have creamy white to light brown. The dried fermented ones are light brown to brown. *Nigaalo Tusa* (*Drepanostachyum* sp.) is light yellowish to green in colour. Table 1 provides the physical characteristics of fresh, wet fermented, dried fermented shoots of *D. hamiltonii* and fresh shoot of *Drepanostachyum* sp.

Table 1. Physical characteristics of fresh, wet fermented, dried fermented shoots of *D. hamiltonii* and fresh shoot of *Drepanostachyum* sp. (Source: Giridhar Amatya, August 2023)

| Physical state | Colour | Texture | Taste (as experienced by authors) | Remarks |
|--|---------------------------|-------------------|-------------------------------------|--|
| Fresh Bamboo Shoots | Creamy white | Crunchy and juicy | Mild sweet, matured portion fibrous | <i>D. hamiltonii</i> obtained from Sindhupalchok and Kavrepalanchok districts. |
| Fermented shoots (<i>Taama</i>) | White and slightly yellow | Soft and juicy | Sour | <i>D. hamiltonii</i> from Sindhupalchok and Chitwan district |
| Dried fermented (<i>SukekoTaama</i>) | Light brown to brown | Gummy | Sour | <i>D. hamiltonii</i> from Lele, Lalitpur district |
| Fresh Nigaalo Shoot (<i>Tusa</i>) | Light yellowish to green | Soft and juicy | Mild sweet, matured portion fibrous | <i>Drepanostachyum</i> sp. from Lele, Lalitpur district |

Chemical Compositions

In all fresh bamboo shoots the moisture content is high (more than 94%). Fresh fermented shoots also have more than 92 % of moisture. Actually, they are sold in the market in the juicy form (Figure 7). The moisture content in the dried bamboo shoot is only 10.85%, fat, crude protein, total ash and carbohydrate are more or less the same in fresh shoots irrespective of their location whereas the carbohydrate percent is very high (41.77 %) in the dried fermented bamboo shoot obtained from Lalitpur district. Similarly, fresh shoots (*Tusa*) obtained from *Drepanostachyum* sp. from Lele, Lalitpur district show no abrupt dissimilarities in moisture content, crude protein, crude fiber, total ash and carbohydrates in comparison to a big variety of bamboo (*Taama bans*). In all fresh bamboo shoots the moisture content is high (more than 94%). Fresh fermented shoots also have more than 92 % of moisture. The nutrient compositions obtained from these species are provided in Table 2.

Table 2. Nutrient composition (%) of fresh, wet and dried fermented bamboo shoots

| S.N. | Sample physical taste | Moisture content (%) | Crude fat (%) | Crude protein (%) | Crude fiber (%) | Total ash (%) | Carbohydrate (%) | Energy (Kcal/100 kg) | Acidity (as Lactic Acid) (%) |
|------|--|----------------------|---------------|-------------------|-----------------|---------------|------------------|----------------------|------------------------------|
| 1 | Fresh Bamboo Shoots <i>Dendrocalamus hamiltonii</i> from Sindhupalchok district | 94.03 | 0.42 | 1.01 | 0.49 | 0.86 | 3.19 | 20.60 | 0.41 |
| 2 | Fresh Bamboo Shoots of <i>D. hamiltonii</i> from Panauti, Kavrepalanchok district | 96.13 | 0.56 | 1.76 | 0.31 | 1.08 | 1.06 | 12.72 | 0.68 |
| 3 | Fresh Fermented shoots (<i>Taama</i>) of <i>D. hamiltonii</i> from Panauti, Kavrepalanchok district. | 92.84 | 0.47 | 1.62 | 0.37 | 0.8 | 3.9 | 26.33 | 1.73 |
| 4 | Fresh Fermented shoots (<i>Taama</i>) of <i>D. hamiltonii</i> from Chitwan district | 94.19 | 0.60 | 2.14 | 0.56 | 0.88 | 1.63 | 20.46 | 1.12 |
| 5 | Dried fermented <i>Taama</i> of <i>D. hamiltonii</i> from Lele, Lalitpur district | 10.85 | 6.56 | 16.78 | 16.24 | 7.8 | 41.77 | 293.2 | 7.4 |
| 6 | Fresh <i>Nigale</i> shoots of <i>Drepanostachyum</i> sp. from Lele, Lalitpur district | 93.03 | 0.28 | 1.49 | 0.65 | 1.21 | 3.35 | 21.84 | 0.32 |

Source: Swoyambhu Man. Amatya, Hasta Bahadur Thapa and Giridhar Amatya, August 2023. Laboratory analysis of samples carried out in the Department of Food Technology and Quality Control (DFTQC), Government of Nepal, August 2023

8. Bamboo shoot and human health

Bamboo shoots have various beneficial properties for human health. A lot of materials are available in these issues. Chongtham and Bisht (2020) have elaborately presented bamboo shoot as super-food and aids in the prevention of cardiovascular diseases, cancer, diabetic and hyper-tension. Acharya *et al* (2023) recently have indicated that bamboo shoots show bio-active compounds and have impact on human health. Chongtham *et al* (2021) have reported that bamboo shoots have antioxidant properties and have potential as future health food. The most predominant anti nutrient in bamboo shoots is Cyanogenic glycosides which ranges from 36.32 to more than 1000 mg/ kg (Chongtham, *et al* 2022). It has been reported that fermentation is the best method for reducing the anti-nutrient content and improving the quality of bamboo shoots.

9. Market of Bamboo Shoots

All three types of *Taama* and *Tusa* are available the market. The price varies as per their freshness, fermented category and their availability. The fresh shoots are available at a local market at a rate of US \$ 1.5 per kilogram (kg). The fermented bamboo shoot is costly (US \$ 1.5-2.0 per kg) in comparison to the fresh one whereas the fermented and dried one is more expensive than the others (US \$ 4.0-5.0 per kg).

Discussion

The energy content (Kcal/100 gm) is high (293.2) in the dried fermented *Taama* of *D. hamiltonii* in comparison to fresh shoots of the same species but the acidity percentage (as lactic acid) is high in dry fermented *Taama* of *D. hamiltonii*. The present laboratory analysis of bamboo shoots is in line with that result obtained by Poonam *et al.* (2001). They have found the nutritional values of Bamboo shoot (*Tender Tusa*)*and fermented shoot (*Taama*)**as follows:

| Constituent | Value * (per 100g) | Value ** (per 100g) |
|-------------------------|--------------------|------------------------|
| Moisture | 88.8 | 91.08 |
| Protein | 3.9 | 3.49 |
| Fat | 0.5 | 0.05 |
| Carbohydrate | 5.7 | - |
| Vitamin C (mg) | 5 | 0.22 |
| Acidity (% Lactic Acid) | - | 1.33 |
| Energy | 43 Kcal | - |

Source: * DFTQC 2017; **Poonam, *et al.*, 2001

Tamang and Sarkar (1995) have reported moisture content of Taama as 89 %. This value corresponds with the values obtained by Poonam *et al* (2001). There is not much difference between the chemical compositions of bamboo shoots obtained from *D. hamiltonii* and that of fresh *Nigale* shoots of *Drepanostachyum* sp. Tamang, *et al* (2012) have pointed out that fermented bamboo shoots have some antimicrobial properties.

Conclusions

Bamboo shoots are being used as one of the vegetable items in Nepal in the form of fresh shoots, fermented, and fermented but dried. Bamboo shoot curry is a MUST item for *Newari* food culture. Various types of bamboos including small variety are being consumed in the form of fresh shoot, fermented one as one of the important food items in Nepal. Some authors have pointed out that *taama* has several properties including antimicrobial but chemical compositions of varieties of bamboos as *taama* food have not been analyzed adequately. All types of *taama* taste sour irrespective of fresh and fermented ones. Sour in taste are their main properties. Fresh shoots are less sour in comparison to the fermented ones. Both forms of bamboo shoots (fermented wet and fermented dry) are available in local market. But *tusa* are available only in its season (June- July). Value addition in *tusa* may bring some market opportunity and hence it has to be initiated. Bamboo shoots have many health benefits and it has the potential for being future health food.

Author Declaration

It is hereby confirmed that the manuscript has been read and approved by all the named authors and there is no conflict of interest. All regulations of our institution/institute/company including intellectual property rights have been followed and there are no impediments to publication.

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Conflict of Interest

The authors declare there is no conflict of interest

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