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Ethnic fermented and preserved fish products of India and Nepal



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ABSTRACT

The people of the Eastern Himalayan regions of Nepal, Bhutan; and Darjeeling hills, Sikkim, Assam, Arunachal Pradesh, Meghalaya, Tripura, Mizoram, and Manipur in North East India prepare and consume different types of traditionally processed smoked/sun-dried/fermented/salted fish products. *Suka ko maacha* and *gnuchi* are ethnic smoked and dried fish products; *sidra* and *sukuti* are sun-dried fish products; *ngari*, *hentak*, *tungtap*, and *shidal* are fermented fish products; and *karati*, *bordia*, and *lashim* are sun-dried and salted fish products. No fish sauce or shrimp products are prepared and used as condiments in the local diet in the Eastern Himalayan regions.

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1. Introduction

People living near coastal regions, lakes, and rivers preserve perishable fish through fermentation, sun drying, smoking, and salting without refrigeration, which are consumed as seasoning, condiments, and side dishes [1]. Some of the ethnic fish products of Asia are *patis* of the Philippines [2], *nam-pla* and *plaa-raa* of Thailand [3], *shottsuru* and *shiokara* of Japan [4], *jeot* of Korea [5], *pindang* of Indonesia [6], *budu* of Malaysia [7], and *nga-pi* of Myanmar [8].

The Himalayan arc extends between latitudes 26°20' and 35°40' North, and between longitudes 74°50' and 95°40' East [9]. Based on population and vegetation, the Eastern Himalayas includes eastern Nepal, Bhutan, Tibet Autonomous Region in China, Darjeeling hills, Sikkim, Arunachal Pradesh in India, and the hills of North East India (Manipur, Mizoram, Nagaland, Tripura, and Assam). The river systems along with their tributaries in the Himalayas exhibit a wide range of gradients from subtropical to alpine zones. Many indigenous species of fish are found in the rivers of Sikkim and Darjeeling hills in India [10]. About 44 species of fish have been reported from the rivers of Sikkim [11]. The Brahmaputra and its tributaries rivers in Assam and Arunachal Pradesh in India contain more than 126 species of fish belonging to 26 families [12]. Logtake Lake in Manipur has varieties of ichthyofauna mostly dominated by species of *Puntius*, *Channa*, *Labeo*, etc. [13]. The present paper is aimed to

document traditionally preserved and fermented fish products of North East India, Nepal, and Bhutan.

2. Ethnic fish products

Seafood is uncommon to Nepal, Bhutan, and North East India. The people of Nepal, Bhutan, and North East India catch the available fish from the various sources—mainly rivers, streams, and lakes—and consume fresh as well as traditionally preserved and fermented fish products [9]. Some of these fish are preserved or processed using centuries-old indigenous knowledge of fermentation/drying/smoking. The ethnic people use their indigenous knowledge of fish preservation and processing without using any extra chemicals. Such fish processing techniques are still present in those regions or villages that are located near water bodies with plenty of freshwater fish. Some villagers sell them in the market area and are economically dependent. Many types of traditionally preserved fish products have been noted, which are consumed in local diet by the people of the regions (Table 1). These traditionally preserved fish products are: *gnuchi* and *suka ko maacha* (smoked and sun-dried fish products), *sidra* and *sukuti* (sun-dried/salted fish products) of eastern Nepal, Darjeeling hills, and Sikkim in India, and Bhutan; *ngari* and *hentak* (fermented fish products) of Manipur; *tungtap* (fermented fish product) of Meghalaya; *karati*, *bordia*, and *lashim* (sun-dried and salted fish products) of Assam; and *shidal* of Tripura (Fig. 1).

3. Gnuchi

Gnuchi is an ethnic smoked fish product of the Lepcha people of Sikkim in India. During its preparation, fish (*Schizothorax*

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Table 1
Ethnic fish products of Nepal and North East India.

Products	Substrate	Nature and use	Microorganisms	Consumption areas	References
<i>Ayaiba</i>	Fish	Smoked fish; pickle, curry	Unknown	Manipur, Mizoram	[14]
<i>Bordia</i>	<i>Pseudeutropius atherinoides</i>	Dried, salted	<i>Lactococcus lactis</i> , <i>Leuconostoc mesenteroides</i> , <i>Lactobacillus plantarum</i> , <i>Bacillus subtilis</i> , <i>Bacillus pumilus</i> , <i>Candida</i> sp.	Assam, Manipur, Mizoram, Arunachal Pradesh	[15]
<i>Chucha</i>	Small fish species (<i>Gudusia chapra</i> , <i>Amblypharyngodon mola</i> , <i>Aspidoparia morar</i> , <i>Chela laubuca</i> , <i>Puntius ticto</i> , etc.)	Sun-dried fish product	Unknown	Assam	[16]
<i>Gnuchi</i>	<i>Schizothorax</i> spp., <i>Labeo</i> sp.	Smoked	<i>L. plantarum</i> , <i>L. lactis</i> , <i>L. mesenteroides</i> , <i>Candida bombicola</i> , <i>Enterococcus faecium</i> , <i>Enterococcus faecalis</i> , <i>Pediococcus pentosaceus</i> , <i>Candida chiropterorum</i> , <i>Saccharomycopsis</i> sp.	Darjeeling hills, Sikkim	[14]
<i>Godak</i>	<i>Puntius</i> spp.	Semifermented, nonsalted product; 4–6 mo fermentation; curry/pickle	Unknown	Tripura	[17]
<i>Hentak</i>	<i>Esomus danricus</i> , petioles of <i>Alocasia macrorhiza</i>	Fermented paste	<i>L. lactis</i> , <i>L. plantarum</i> , <i>Lactobacillus fructosus</i> , <i>Lactobacillus amylophilus</i> , <i>Lactobacillus coryniformis</i> , <i>E. faecium</i> , <i>B. subtilis</i> , <i>B. pumilus</i> , <i>Micrococcus</i> sp., <i>Candida</i> sp., <i>Saccharomycopsis</i> sp.	Manipur	[18]
<i>Hidal</i>	Small fish	Semifermented	Unknown	Assam	[19]
<i>Hukoti</i>	Small	Dried; side dish	Unknown	Assam	[20]
<i>Japangangnagtsu</i>	Crab (<i>Scylla</i> sp.) with sesame	Fermented; side dish	Unknown	Nagaland	[21]
<i>Karati</i>	<i>Gudusia chapra</i>	Dried, salted	<i>L. lactis</i> , <i>L. mesenteroides</i> , <i>B. subtilis</i> , <i>L. plantarum</i> , <i>B. pumilus</i> , <i>Candida</i> sp.	Assam, Meghalaya	[15]
<i>Lashim</i>	<i>Cirrhinus reba</i>	Dried, salted	<i>L. lactis</i> , <i>L. mesenteroides</i> , <i>B. subtilis</i> , <i>L. plantarum</i> , <i>B. pumilus</i> , <i>Candida</i> sp.	Assam, Meghalaya	[15]
<i>Lona Illis</i>	Indian shad (<i>Tenualosa ilisha</i>)	Salted, fermented	<i>Staphylococcus aureus</i> , <i>Micrococcus</i> sp., <i>Bacillus</i> sp	Tripura	[22]
<i>Mio</i>	Fish	Dried; curry	Unknown	Arunachal Pradesh	[14]
<i>Naakangba</i>	Fish	Sun-dried; pickle, curry	Unknown	Manipur, Nagaland	[14]
<i>Naduba siyan</i>	Fish	Sun-dried fish product	Unknown	Assam	[16]
<i>Nah-grain</i>	Small fish	Dry, solid; pickle, curry	Unknown	Assam	[24]
<i>Namsing</i>	<i>Puntius</i> spp., <i>Amblypharyngodon mola</i> , <i>Channa</i> spp., <i>Mastacembellus</i> spp., <i>Labeo bata</i> , <i>Anabus testideneus</i> , <i>Colisa</i> spp., <i>Danio</i> spp., <i>Botia</i> spp., etc. along with some plant materials such as <i>Colocasia (Alocasia macrorhiza)</i> , <i>Shizu</i> leaves (<i>Euphorbia nerifolia</i>), or <i>Tage</i> leaves (<i>Natsiatium herpeticum</i>)	Sun dried fish products; curry	Unknown	Assam	[25]
<i>Ngari</i>	<i>Puntius sophore</i>	Fermented	<i>L. lactis</i> , <i>L. plantarum</i> , <i>E. faecium</i> , <i>L. fructosus</i> , <i>L. amylophilus</i> , <i>L. coryniformis</i> , <i>B. subtilis</i> , <i>B. pumilus</i> , <i>Bacillus indicus</i> , <i>Micrococcus</i> sp., <i>Staphylococcus cohnii</i> subsp. <i>Cohnii</i> , <i>Staphylococcus carnosus</i> , <i>Tetragenococcus halophilus</i> subsp. <i>Flandriensis</i> ; <i>Candida</i> sp., <i>Saccharomycopsis</i> sp.	Manipur	[18,26]
<i>Sepaa</i>	Small fish	Dried	Unknown	Tripura, Nagaland, Arunachal Pradesh	[19]
<i>Shidal</i>	<i>Puntis</i>	Semifermented, nonsalted product; 4–6 months fermentation; curry/pickle	<i>S. aureus</i> , <i>Micrococcus</i> spp., <i>Bacillus</i> spp., <i>Escherichia coli</i>	Tripura, Assam	[19,27]
<i>Sidra</i>	<i>Puntius sarana</i>	Dried	<i>L. lactis</i> , <i>L. plantarum</i> , <i>E. faecium</i> , <i>L. mesenteroides</i> , <i>E. faecalis</i> , <i>P. pentosaceus</i> , <i>Weissella confusa</i> , <i>Candida chiropterorum</i> , <i>Candida bombicola</i> , <i>Saccharomycopsis</i> sp	Nepal, Bhutan, India (Darjeeling hills, Sikkim)	[28]
<i>Suka ko maacha</i>	<i>Schizothorax</i> spp.	Dried/smoked	<i>L. lactis</i> , <i>L. plantarum</i> , <i>E. faecium</i> , <i>L. mesenteroides</i> , <i>E. faecalis</i> , <i>W. confusa</i> , <i>P. pentosaceus</i> , <i>C. chiropterorum</i> , <i>C. bombicola</i> , <i>Saccharomycopsis</i> sp	Nepal, Bhutan, India (Darjeeling hills, Sikkim)	[28]
<i>Sukuti</i>	<i>Harpodon nehereus</i>	Dried, salted	<i>L. lactis</i> , <i>L. plantarum</i> , <i>E. faecium</i> , <i>L. mesenteroides</i> , <i>E. faecalis</i> , <i>W. confusa</i> , <i>P. pentosaceus</i> , <i>C. bombicola</i> , <i>C. chiropterorum</i> , <i>Saccharomycopsis</i> sp	Nepal, Bhutan, India (Darjeeling hills, Sikkim)	[28]

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