



Consumption Pattern of Dry and Fermented Fish Products in North Eastern Region of India

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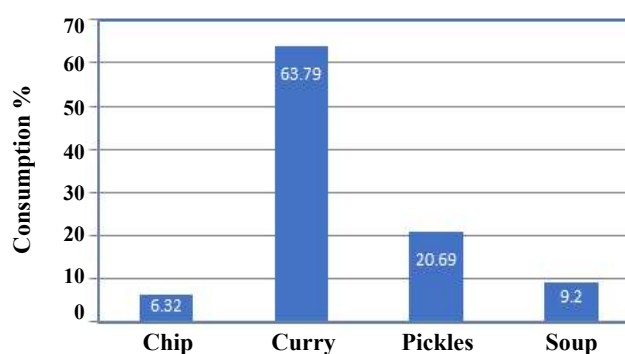
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HIGHLIGHTS

- Family size of the respondents affected both the consumption of dry and fermented fishes in NE Region of India
- Most of the respondents prefer to consume dry and fermented fishes as fish curry.
- From AHP criteria, taste was emerged as more important criteria for dry and fermented fish consumption followed by price, fishbone and nutrition in the North Eastern Region in India.

GRAPHICAL ABSTRACT

Consumption Preference of dry and fermented fish products



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ABSTRACT

Introduction: The consumption of dry and fermented fish products is deeply rooted in the cultural and culinary heritage of North East India. All the fermented products are region specific and have their own unique substrates and preparation methods.

Context: The consumption trends of dry and fermented fish is different in North Eastern Region of India and the preference of consuming those products also varies which enables to consider consumption trends as an important analytical variable in this research.

Objective: The objective of this study is to analyze the consumption trends of the respondents and to identify factors affecting the consumption of dry and fermented fishes in NER.

Method: The study is based on primary data collected through online survey method for which a questionnaire framed in Google Form. The sample comprises of total 174 respondents from NER. Stepwise regression (SR) model was used to identify factors affecting the consumption of dry and fermented fishes in NER. Analytic Hierarchy Process (AHP) was applied to explore the decision criteria of the respondents to consume different dry and fermented fish products.

Result and Discussion: It was found that family size of the respondents significantly affect the consumption pattern of dry and fermented fish. The consumption preference of the respondents reflects that most of the respondents (63.79%) prefer to consume dry and fermented fish as fish curry. AHP explored the decision criteria of the respondents and taste was emerged as more important criteria for dry and fermented fish consumption followed by price, fishbone and nutrition.

Fish is a valuable source of high-quality protein, essential omega-3 fatty acids, vitamins, and minerals that make a vital contribution to the world's food and nutrition security (FAO, 2020). The consumption of fish is essential for optimal development of the brain and neural system of the children, as omega-3 fatty acids in the form of docosahexaenoic (DHA) rather than alpha-linolenic acid (ALA) are required for optimal brain development (Hasselberg *et al.*, 2020). Incorporating fish into a balanced diet supports various aspects of physical well-being. The World Health Organization (WHO) recognizes the nutritional value of fish and recommends its consumption as part of a healthy diet. Fermented fish is a traditional preservation of fish. Like Southeast Asian countries fermented fish is a well-known strategy of food preservation of tribal people (Goswami *et al.*, 2022) in the North-East region of India. Ngari (Shidal) are mostly preferred salt-free fermented fish product amongst all. Puntius Shidal is rich in omega-3 but poor in omega-6 fatty acid chain (MHC) in the dry Puntius fish (raw material of Shidal). Proteins or peptides with low molecular weight were noticed in both the Shidal and indicative of intensive protein degradation during fermentation. Therefore, fermented fish products could be used as a potential source of nutrients and natural antioxidants.

North East India is characterized by a diverse population of people with different ethnic background. Most of the people of this region are tribal and bear their own methods of fermenting food materials for the purpose of preservation and taste enhancement and they have been carrying these from time immemorial. All the fermented products are region specific and have their own unique substrates and preparation methods. Materials such as soybeans, bamboo shoots and locally available vegetables are commonly fermented by most of the tribes. The fermented alcoholic beverages prepared in this region are unique from the rest of the world in several aspects and bears deep attachment with the socio-economic status (Upadhyay *et al.*, 2022, Jhansi and Kalal, 2022) and cultural lives of the people. These products also serve as a source of economy to many of the rural people, who prepares them at home and market locally.

The indigenous people of North-Eastern India believed that malaria (Muzaddadi and Basu, 2012) can be cured by using Shidal. Hentak is eaten with cooked rice as a seasoning and as a curry both. At times,

Hentak is administered to expectant moms and patients who are recovering (Kumar *et al.*, 2013). To delay the growth of spoilage and pathogenic bacteria, care must be made to ensure hygienic handling procedures and food safety during the fermentation process. Hentak is a must side dish or as an ingredient for dish for nursing women in Manipur from the time immemorial. It has much remarkable and scientific reason also. Fermented fish products are consumed almost everywhere in North East India, generally as a condiment for rice dishes (Singh *et al.*, 2019). Fermented foods in varied forms are widely consumed by different races of the world and have their own models of fermentation. Manipur is the corridor of all other North-Eastern states, being a predominantly fermented fish consuming state. The demand for fermented fish is very high in the North-Eastern state. Fermented fish processing is an artisanal activity and the process differs from one country to another. Indigenous fermented fish product, viz. Karoti in Assam, Tungtap in Meghalaya, Sidra in Sikkim and Ngari in Manipur are traditionally consumed by the tribal people of these region. 'Ngari' is an indigenous fermented fish product of Manipur. Jagiroad dry fish market, situated in Morigaon district of Assam, is one of the largest dry fish markets in Asia, which receives dry fish products from all parts of the country (Upadhyay *et al.*, 2017). Like the fresh fish marketing system in India, the dry fish marketing is not well organized. Most of the studies were dealt with fresh fish marketing (Mallick and Deka, 2022).

Various tribes in North East India have a rich culinary tradition that includes the consumption of dry and fermented fish products. But a few numbers of studies have been conducted on consumption behavior of dry and fermented fish in NE India. So, in the present paper an attempt has been made to study the consumption behavior of dry and fermented fish in NER. The consumption behavior will lead to effective decision making (Borah *et al.*, 2018) to the planners and enable the entrepreneurship development (Saikia, 2017) in this sector.

The primary objective of this study is to analyze the consumption pattern of the respondents and to identify factors affecting the consumption of dry and fermented fishes in NER.

METHODOLOGY

This study covered all the states of North Eastern Hill states such as Manipur, Tripura, Meghalaya,

Mizoram, Arunachal Pradesh Nagaland and Sikkim. Keeping in view the limitations of personal interview method for data collection due to limited cost and time, online survey method was used to collect primary data during July-September, 2023. A structured questionnaire including closed and open-ended questions was framed using Google Form. A total of 174 responses from all the states of North East Region were received.

Stepwise regression (SR) model was used which is the step-by-step iterative construction of a regression model that involves the selection of independent variables. SR model involved adding or removing potential explanatory variables in succession and testing for statistical significance after each iteration. The Analytic Hierarchy Process (AHP) method was used for structuring the decision-making process which outlined the priorities by comparing the variables for dry/fermented fish consumption in pairs, such as comparing one variable against another. The Analytic Hierarchy Process (AHP), given by Saaty (2008), used pairwise comparison questions to elicit a matrix of judgments of the relative preference between each pair of alternatives with respect to each attribute, and a matrix of judgments of the relative importance of each pair of attributes.

Further, the responses in the Google forms were converted into the numeric values and analyzed it using MS Excel and SPSS-22. The descriptive statistics for the socio-economic variables was analyzed to explore the general information about the respondents. Stepwise regression was used to identify factors responsible for consumption of dry and fermented fishes. Finally, Analytic Hierarchy Process (AHP) was applied to explore the decision /preference of the respondents to consume different dry and fermented fish products.



Location of study area North Eastern Region of India

Table 1. Socio-economic profile of the respondents (N=174)

Profile	No.	%
<i>Gender</i>		
Male	108	62.07
Female	66	37.93
<i>Category</i>		
General	64	36.90
SC	26	14.90
ST	38	21.80
OBC	46	26.40
<i>Location</i>		
Rural	68	39.10
Urban	106	60.90
<i>Monthly expenditure</i>		
Less Than 1000	116	66.67
1000-5000	42	24.13
More than 5000	16	9.20
<i>Family Size</i>		
<3	2	1.15
3-5	136	78.16
>5	36	20.69
<i>Distance of the market from household</i>		
Within 2 KM	123	70.69
2-5 KM	37	21.26
>5 KM	14	8.05

RESULTS

An online survey was conducted on 'Consumption of Dry and Fermented Fish Products in North Eastern Region of India' and the results of the study are presented below-

The socio-economic profile of the respondents, including per centage of male and female respondents, families belonging to different family size, location, monthly expenditure, distance from market and income groups were analyzed and results is presented in Table 1. It was found that about 62.07 per cent respondents belonged to male and 37.93 per cent were females. The result revealed that 1.15 per cent respondents have family size <3 members, whereas, 78.16 per cent respondents have family size 3-5 members and 20.69 per cent respondents have family members >5 members. The 36.8 per cent of the residents were from general category, 14.9 per cent from SC category, 21.8 per cent from ST category and 26.4 per cent belonged to OBC category. It was observed that 60.9 per cent respondents belonged to urban area and 39.1 per cent respondents from rural area. 66.67 per cent respondents have monthly expenditure on dry and fermented fish is below Rs 1000/-, 24.14 per cent

Table 2. Weekly family consumption (in kg) of Dry and fermented fish (N=174)

Family consumption	No.	%
Dry Fish/week		
Below average (<2.59)	126	72.41
Above average (>2.59)	48	27.59
Fermented Fish/week		
Below average (<2.42)	120	68.97
Above average (>2.42)	54	31.03

respondents have monthly expenditure between Rs. 1000 to 5000/-whereas, 9.20 per cent respondents have monthly expenditure above Rs. 5000/-. It was also observed that 70.69 per cent respondents reside within 2 km from market, 21.26 per cent respondents reside 2-5 km distance from market whereas 8.05 per cent respondents reside more than 5 km distance from market.

Table 2 describes the weekly consumption pattern of the respondents. The average weekly consumption of dry and fermented fish of the respondents was 2.59 kg and 2.42 Kg respectively. However, 72.41 per cent of respondents reported their weekly consumption of dry fish below the average consumption (2.59 kg/week) and 27.59 per cent of respondents' weekly consumption was above the average consumption (2.59 kg/week) of Dry Fish. While in case of fermented fish, 68.97 per cent of respondents consume above average (2.42

Table 3. Factors affecting the Consumption of Dry & Fermented Fish (N=174)

Model	Coefficients		t	p value
	B	SE		
<i>Dry Fish</i>				
Constant	-1.581	0.965	-1.638	0.103
Family size	0.937	0.201	4.652	0.000
Location	-0.340	0.731	-0.466	0.642
Caste	-0.104	0.304	-0.344	0.731
Religion	-0.121	0.456	-0.265	0.791
Distance from market	0.432	0.563	0.767	0.444
Monthly income	0.725	0.426	1.701	0.091
<i>Fermented Fish</i>				
Constant	-1.684	0.958	-1.758	0.080
Family size	0.957	0.200	4.787	0.000
Location	-0.129	0.726	-0.177	0.859
Caste	-0.160	0.302	-0.530	0.597
Religion	0.071	0.454	0.157	0.875
Distance from market	0.274	0.560	0.489	0.626
Monthly Income	0.588	0.424	1.387	0.167

a. Dependent Variable: Consumption of Dryfish

b. Dependent Variable: Consumption of fermented fish

kg/week) and 31.03 per cent of respondents' weekly consumption was below the average consumption (2.42 kg/week). It indicates skewed distribution of respondent with respect to consumption Dry and fermented Fish in NE Region.

The stepwise regression model was applied to find out the factors influencing dry and fermented fish consumption. The model included the statistically significant factor i.e. family size which affected significantly ($p < 0.05$) both the consumption of dry and fermented fishes. The ANOVA ($p < 0.05$) reflects that the model is statistically significant and model coefficient for both the dry and fermented fishes are given in Tables 3. The household size is only significantly affecting weekly consumption of both dry fish as well as fermented fish in NEH region. The other non-significantly affected variables (location, caste, religion, distance from market and monthly income of the respondents) are presented in Tables 3.

The consumption preference of the respondents is graphically presented in Fig.1 which reflects that most of the respondents (63.79%) prefer to consume as fish curry, 20.69 per cent respondents prefer to consume as pickles, 9.2per cent respondents like soup whereas 6.32 per cent respondents prefer chips.

AHP allows respondents to choose the most appropriate options with pairwise comparisons of required criteria and option (Saaty, 2008). The AHP model identifies the most important criteria influencing

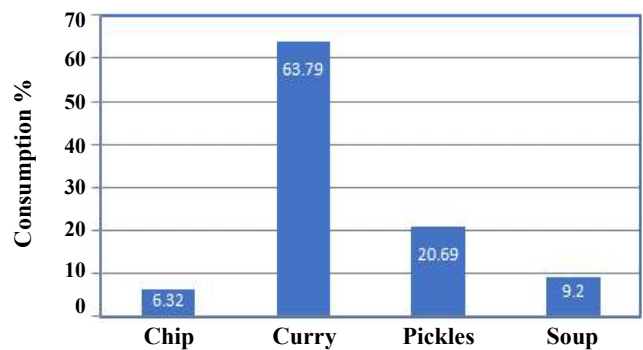


Fig. 1. Consumption Preference of dry and fermented fish products

Table 4. Preference of the consumers for dry and fermented fish products

Standardized Matrix	AHP Weight %	Rank
Taste	42.00	I
Price	26.00	II
Fish Bone	20.51	III
Nutritional Value	11.52	IV

dry and fermented fish choice by consumers. Table 4 shows an explanatory statistic of the AHP criteria among consumers. From these standards, taste was most important criteria (42%), followed by price (26%), fishbone (20.51%) and nutrition (11.52%).

DISCUSSION

The finding of the research study demonstrates that the consumption of dried and fermented fish products in the North Eastern Region (NER) of India is highly impacted by cultural, socio economic, and ecological factors. Culturally, these indigenous fish products held importance in regional diets and traditions, often deeply rooted in tribal rituals and taste preferences. Economically, they sustain livelihoods in fishing and processing sectors while giving affordability compared to fresh fish. Ecologically, they contribute in resource conservation by preserving fish during lean seasons and enhancing climatic resilience. Identifying these aspects is vital for supporting local livelihoods, increasing food security, and conserving the culinary legacy of the area (Marak, T. 2021). Furthermore, it's delicate flavour, high nutritional value and involvement of local ingredients, fermented fish products have become one of the most popular native foods in the north-eastern region (Majumdar *et al.*, 2016). The demographic factors and fish consumers' preferences, indicate that the 37.93 per cent of respondents were female while 62.07 per cent were male. A significant amount of expenditure on dried fish and fermented fish products reflects higher consumer preference for instance 9.2 per cent respondents have monthly expenditure above Rs. 5000.

According to Marushka *et al.*, (2021), fish consumption was found to be positively correlated with household size. The results furnished in Table 3 confirmed that family size of the household significantly affect the dry and fermented fish consumption because of larger families often have greater food requirements, and dry and fermented fish products can serve as affordable sources of protein that can be stored for longer periods (Is *et al.*, 2017). The average monthly consumption of the household is 2.6 kg. One of the earliest and most affordable ways to keep food safe with high quality is through fermentation (Das and Deka, 2012). The indigenous people consume Shidal daily by preparing a variety of dishes such as Shidal chutney, which has malaria-curing properties (Muzaddadi and Basu, 2012). The north eastern local population uses Indian fermented

foods both as traditional medicine and part of their diet. Because of the main microorganisms for fermentation are lactic acid bacteria (LAB), which are often referred to as probiotics, or good for human health. In basic terms, fermentation enhances and improves food's flavour, fragrance, and texture; it also produces organic acids that help preserve food; it increases nutrition; it minimizes endogenous toxins; it speeds up cooking; and it uses less fuel. These products are consumed in many edible forms (Das *et al.*, 2016; Ray *et al.*, 2023). Fig. 1 reveals that most of the respondents prefer to consume as fish curry, followed by pickles, soup and chips.

The consumers' choice for fish was depending on price, nutrition, fishbone and taste (Uzundumlu, 2015). This study identified the most important criteria (using AHP weight) influencing fish choice of consumers and taste was emerged as most important criteria, followed by price, fishbone and nutrition.

CONCLUSION

From the study it is concluded that the level of consumption of dry and fermented fish products in NEH region is determined by family size. The consumer taste and preference were emerged as more important factors for consumer choice for dry and fermented fish products followed by price, fishbone and nutrition. Most of the respondents prefer to consume dry and fermented fishes as fish curry. Therefore, for promoting these products in NEH region collective efforts are needed from marketing companies/NGO and Govt. sectors etc. by adopting proper production and marketing strategies. Furthermore, there is a critical need for awareness programmes emphasizing the health advantages of consumption dry and fermented fish, especially among women and children. Such initiatives will assure people about nutritional values, dietary diversification and overall improvement of the food security in NEH Region of India.

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Conflicts of interest: The authors have no conflicts of interest.

Appendix: Supplementary data : The supplementary data (table for online visibility to the readers) are submitted as an appendix.

Data availability: Data would be made available on request.

Author's contribution: The first author participated in contributing to text, conceptualization of the work, content of the manuscript, analysed the data and interpreted the results. The second author edited and revised the manuscript. The third author edited the manuscript. The fourth and fifth author participated in contributing to text and the content of the manuscript and collected data. The authors approve of the content of the manuscript and agree to be held accountable for the work.

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