Quality of fermented fish in Myanmar

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1. Introduction

In Myanmar, fish is an important source of bioavailable protein and essential nutrients, and accounts 50% of the diet (So-Jung *et al.*, 2018). Aside from fresh fish, Myanmar people consume processed fish such as dried fish, fish paste, pickled fish (boiled rice with fish) and fish sauce at least 6.5 kg/capita/year (Belton *et al.*, 2017). These products are nutrient dense which can support addressing nutrient gaps among women and young children who are those who mostly suffer from undernutrition and micronutrient deficiencies.

Despite its popularity, the safety of the products remains questionable, several reports have revealed the presence of bacteria (Kobayashi *et al.*, 2016), parasites (Shinn, 2020), and exposure to pesticides and heavy metals (Belton *et al.*, 2022), which make the products unfit for human consumption. Adding to the conundrum is that since salt is used for fermentation process, the majority of the products have a high sodium chloride content which has associated risks when consumed by people suffering from hypertension and other non-communicable diseases (Zang *et al.*, 2020). Therefore, it is imperative that processors adopt improved food safety practices and processing technologies to ensure good quality products are available for local consumers.

The aim of this study is to confirm the quality of fermented fish[1] taken from 5 region/states (Magway, Sagaing, Kachin, Southern and Eastern Shan) in Myanmar where WorldFish has an ongoing project. WorldFish researchers collected and submitted the fermented fish samples to a local laboratory for nutrition, microbial, and heavy metals analyses.

This report highlights the key results of the analyses which can be used as a reference for future interventions among research organizations, non-government organizations, and private companies working in the fisheries sector on food processing and food safety standards.

2. Materials and Methods

2.1 Sample collection

WorldFish researchers collected the samples in May 2023 over a period of 12 days at the local market and/or at the processor's premises in WorldFish project areas. A total of 15 fermented fish samples were collected from randomly selected areas (Table 1). Refer to the annex section for the composition of each sample.

[1] For this report, fermented fish refers to fish paste and/or pickled fish (cooked rice with fish)

Agro-ecological zones	Township & Region	No. of samples
Upland	Kengtung, Eastern Shan State	2
	Nyaung Shwe, Southern Shan State	2
	Myitkyina, Kachin State	2
Central Dry Zone	Salin, Magway Region	3
	Wetlet, Sagaing Region	1
	Mandalay, Mandalay Region	1
Delta	Yangon, Yangon Region	2
	Nyaung Don, Ayeyarwady, Delta	2
Total Samples		15

Table 1. List of Townships selected for sample collection.

For the sample collection, the researcher followed a protocol adapted from previous work by WorldFish and the FishVet group in the country to ensure samples were of good quality, free of cross contamination and correctly labelled. As part of the data collection process, the researchers utilized a questionnaire uploaded on the Kobo application software, questions included were: place of origin, process of paste production, the product's proposed shelf-life, and the ingredients, specifically, the fish species used in the formulation of the products.

The researchers informed the processor/shop keeper on the purpose of the sample collection and consent was sought. For each sample, 1.6 kilograms of the product was placed in resealable zip-lock bags, labelled, and then placed inside another resealable zip-lock bag before placing in a plastic box container. After sample collection, the researcher interviewed the shop keeper/ processor for the supporting information and samples were transferred and stored in a domestic refrigerator at 4˚C.

The samples were stored for a maximum of 15 days and then were sent to the Myanmar Innovative Life Sciences (MILS) laboratory in Yangon for the analyses.

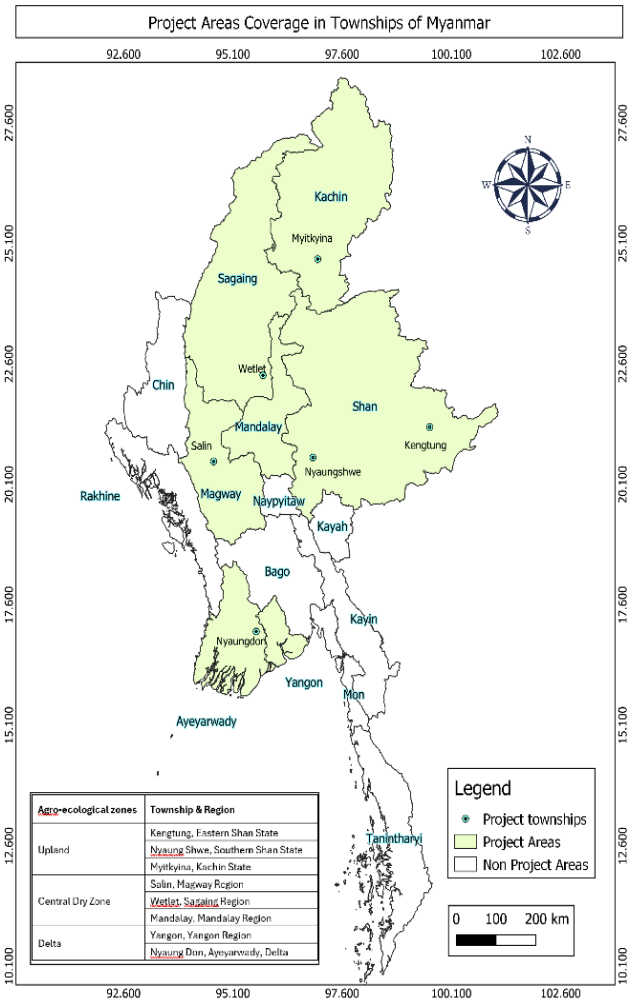

Figure 1. Map showing the townships selected for sample collection. Illustrated by: Ei Ei Phyo, WorldFish.

2.2. Laboratory Analyses

A qualified Medical Biotechnologist at the Myanmar Innovative Life Sciences laboratory in Yangon conducted the analyses. The parameters selected are based on the food safety standard requirements that signify food is safe for human consumption. Iron, zinc, calcium were analyzed due to their public health importance. Although Vitamin A is an important nutrient and of public health concern in the country, the laboratory did not have the capacity to test for the vitamin. Table 2 below summarizes the methods used for analyses.

Methods	Parameters
Kjeldahl AOAC 2019 2001.11	Protein
Buchi Soxhlet method (Ether extract) 2019 954.02	Crude Fat
AA-7000	Sodium, Calcium, Iron, Zinc, Arsenic, Mercury
FOSS ASN 3140	Total Volatile Basic Nitrogen (TVBN) (mg/100g)
AOAC 2019 925.10	Moisture, Ash
ELISA kit	Histamine
Compact Dry method	Total Plate count, *B. cereus,* yeast and mold, *S. aureus*, Total coliform, *E. coli*
Agar methods	*Salmonella*

Table 2. Methods used for analyses.

3. Results and Discussion

3.1 Nutrient Composition

For ease of interpretation, the data was converted to a tablespoon or 15 grams (Table 3) since fish paste is usually consumed in small amounts as a condiment in Myanmar.

All the samples showed a protein content with a range of 1.9-9.7g for 1 tablespoon, sample 4 had the highest percentage contribution of protein (20%) to the estimated average requirement (EAR) for adults per day. The main ingredient in fish paste is fish of various species and sizes which explains the high protein content. While the fat content ranges <1 to1.2g, the EAR contribution is 2% per tablespoon for an adult per day.

The calcium content was as high as 300mg with most of the samples in the Central Dry zone contributing nearly 40% of EAR contribution for adults per day. When fermenting fish, whole fish with heads and bones where calcium is stored are often included resulting in high calcium content. In Myanmar, where milk and milk products are not widely consumed, fish-based products are an alternative to strengthen bones and teeth among children. However, adoption of improved processing practices is needed.

While for Iron, only two samples (7 and 14) contribute over 10% of EAR per day. In Myanmar, almost 50% of the women of reproductive age are anemic which has negative implications for health and productivity.

Zinc is present in all the samples. Zinc plays an important function in maintaining intestinal cells, bone growth and immune function, children who are deficient showed stunted growth and are prone to diarrheal diseases.[2]

Figure 2. Fish paste from Ayeyarwady, Delta.

Meanwhile for Sodium, half of the samples contain >50% of the EAR per day, which is high especially as meals throughout the day contain salt, exceeding the limit for the day. High salt intake is associated with increased risks of hypertension and other non-communicable diseases. With the increased poverty and high inflation rates in Myanmar, the cost of nutritious food increased by 130% (IFPRI and MAPSA, 2024), resulting in households limiting meals to staples, fish paste, and vegetables. Hence, there is a need for improved practices that minimize the use of salt by sub4tituting ingredients (e.g. Potassium Chloride) and use of other methods (e.g. electrodialysis) to hasten the fermentation process (Zang *et al.*, 2020).

[2] https://www.who.int/tools/elena/bbc/zinc-pneumonia-children

Areas	Sample	Protein (15g)	% EAR (15g)	Fat (15g)	% EAR (15g)	Calcium (mg/kg); converted to 15g	% EAR (15g)	Iron (mg/kg); converted to 15g	% EAR (15g)	Zinc (mg/kg); converted to 15g	% EAR (15g)	Sodium (15g)	% EAR (15g)
Upland	FP#1	2.6	5.1	0.9	1.7	108.8	12.7	0.3	1.2	0.3	3.9	795.0	39.8
	FP#2	2.5	4.9	0.5	1.0	80.4	9.4	ND	ND	0.2	2.4	325.5	16.3
	FP#3	3.1	6.2	0.5	1.1	17.0	2.0	0.0	0.2	0.1	1.3	1050.0	**52.5**
	FP#4	9.8	**19.5**	0.1	0.1	11.8	1.4	ND	ND	0.1	1.1	75.0	3.8
	FP#9	4.2	8.4	1.2	2.3	55.2	6.4	ND	ND	0.4	5.9	394.5	19.7
	FP#10	2.5	4.9	0.3	0.5	57.4	6.7	ND	ND	0.1	1.5	286.5	14.3
Central Dry Zone	FP#5	2.5	4.9	0.8	1.5	219.9	25.6	ND	ND	0.4	5.5	750.0	37.5
	FP#13	1.9	3.8	0.3	0.7	108.9	12.7	0.8	3.9	0.2	2.2	990.0	49.5
	FP#14	3.0	5.9	0.6	1.3	221.1	25.7	2.3	10.8	0.4	5.5	607.5	30.4
	FP#15	2.0	3.9	1.3	2.5	337.3	**39.2**	1.0	4.7	0.4	5.5	990.0	49.5
Delta	FP#7	2.6	5.1	0.6	1.2	63.6	7.4	2.5	**12.0**	0.3	4.8	1153.5	**57.7**
	FP#8	2.2	4.4	1.1	2.3	201.1	23.4	1.8	8.6	0.6	8.3	2149.5	**107.5**
	FP#11	2.4	4.8	1.1	2.2	263.6	**30.7**	1.5	7.4	0.2	3.5	1057.5	**52.9**
	FP#12	1.8	3.6	1.2	2.5	156.8	18.2	ND	ND	0.5	7.0	1320.0	**66.0**

Table 3.Results from the nutrient analysis. Estimated Average Requirement (EAR); 1 tablespoon=15grams, sample 7 is excluded due to lack of data.

3.2 Microbes and Heavy Metals

Consumption of foods contaminated by microbial agents cause illnesses and other diseases that can lead to disability and death when not treated appropriately.

Based on the samples collected (Table 4), *Escherichia coli,* mostly found in undercooked foods, was detected in 3 of 14 samples. The most common pathways of transmission are contaminated water, unwashed vegetables and undercooked meat products, as the bacteria is usually of ruminant and dog origins. However, in a rural cottage industry where there is poor observance of food safety standards, the risk of contamination is high.

Salmonella spp. was detected in 50% of the samples, *Salmonella* is one of global causes of diarrheal diseases.[3] *Staphylococcus Aureus* was present in the majority of the samples (12 of 14), as humans are the main source of this bacteria. Toxins produced by the bacteria can cause poisoning leading to diarrhea, vomiting and nausea.[4]

Yeast and molds and the total plate count showed that they are within the allowable levels according to regulatory standards in Myanmar. While for total coliforms, 60% of the samples are higher than the allowable levels which indicate poor hygiene standards.

[3] https://www.who.int/news-room/fact-sheets/detail/salmonella-(non-typhoidal)

[4] https://www.cdc.gov/staph-food-poisoning/about/index.html#:~:text=Staphylococcus%20aureus%20(Staph)%20are%20bacteria,toxin%20that%20causes%20food%20poisoning.

For mercury and arsenic, the latter was detected in one sample. Arsenic has two forms: organic and inorganic, the latter is highly toxic. Inorganic arsenic which is mostly found in contaminated drinking water from groundwater origin. However it can get into the food chain, a recent study documented the presence of arsenic in freshwater fish species from lakes, rivers and aquaculture in Thailand and elsewhere (Hoy *et al.*, 2023). The long-term exposure leads to cancer and cardiovascular diseases.

While for mercury, two samples were contaminated which can have negative effect on the nervous, digestive and immune systems. Pregnant women exposed to mercury can have a debilitating effect on their fetuses. [5] All of the samples contain histamine, produced by the bacterial breakdown of unrefrigerated fish and fish products, however the contamination levels are below 200ppm which is the limit to have an adverse effect on humans like nausea, vomiting, diarrhea, and itching. [6]

Areas	Sample	*E. coli* cfu/g	*Salmonella spp.*	*S. Aureus* cfu/g	Yeast & Mold cfu/g	Total Coliform cfu/g	Total Plate Count cfu/g	Histamine	Arsenic (mg/kg)	Mercury (µg/kg)
Upland	**FP#1**	$1.4x10^5$	Detected	$3.9x10^4$	$4.5 x10^3$	$3.9 x10^5$	$4.0x10^6$	< 10 ppm	ND	47
	FP#2	ND	Detected	$8x10^3$	$1x10^3$	$10x10^3$	$1.28x 10^3$	13.58 ppm	ND	ND
	FP#3	$3x10^1$	ND	$1x10^3$	$3x10^1$	$3.6x10^4$	$8.0x10^4$	14.87 ppm	ND	ND
	FP#4	ND	ND	$7x10^1$ c	$4x10^1$	ND	$1x10^4$	< 10 ppm	ND	ND
	FP#9	$4x10^4$	ND	$3.0x10^4$	$1.0x10^5$	$1.0x10^6$	$9.0x10^6$	< 10 ppm	ND	ND
	FP#10	ND	ND	ND	$3.8x10^5$	ND	$1.9x10^4$	< 10 ppm	ND	ND
Central Dry Zone	**FP#5**	ND	Detected	$3x10^1$	$10x10^1$	ND	$1.3x10^5$	< 10 ppm	ND	ND
	FP#13	ND	ND	$1.45 x10^5$	$1.0 x10^2$	$1.3 x10^6$	$9.4x10^4$	< 10 ppm	ND	ND
	FP#14	ND	Detected	$8.3 x10^2$	$3x10^1$	ND	$2.2 x 10^5$	< 10 ppm	ND	ND
	FP#15	ND	Detected	ND	ND	ND	$9x10^4$	15.99 ppm	ND	ND
Delta	**FP#7**	ND	ND	$4.0x10^4$	$3x10^1$	$1x10^3$	$1.14x10^5$	< 10 ppm	90 mg/kg	33
	FP#8	ND	ND	$8x10^3$	ND	ND	$1.9x 10^3$	< 10 ppm	ND	ND
	FP#11	ND	Detected	$9.0x10^3$	$1.0x10^2$	ND	$1.0x10^5$	< 10 ppm	ND	ND
	FP#12	ND	Detected	$1.4x10^4$	ND	ND	$1.1x10^5$	< 10 ppm	ND	ND

Table 4.Results from microbial and heavy metal analyses. One sample has incomplete data.

4. Conclusions

The report highlights the results of the chemical and heavy metal testing of fermented fish samples in selected areas in Myanmar. Based on the results, the nutritional content of the samples depends on the types and diversity of fish species used and the methods of production. In the Ayeyarwady Delta, it was apparent that all samples have high sodium content (>50% of EAR for adult per day) as vendors practice adding salt before displaying the paste at the market.

[5] https://www.who.int/news-room/fact-sheets/detail/mercury-and-health#:~:text=People%20may%20be%20exposed%20to,Cooking%20does%20not%20eliminate%20mercury.
[6] https://www.tandfonline.com/doi/epdf/10.3109/15563658908994420?needAccess=true

The presence of microbial agents in most of the samples indicate poor food safety and hygiene practices. This poor hygiene coupled with the contamination both arsenic and mercury (two samples) are issues that need to be addressed since long term exposure has debilitating effects on human health. Therefore, improved processing practices are required to ensure good quality fermented fish is available for local consumers.

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6. Annex

6.1 Samples detailed information

Sample number	Common/ Traditional name of the product	Price of products per viss	Production area	Main ingredients	Proportion of ingredients	Type of fish/shrimp species used	Source of fish	Method of production
001_KT	Shan Ngapi (Ki par)	Above 12000 MMK	Kengtung, Eastern Shan	Fish, salt, red chilli flakes.	1 viss of fish, 10 tical of chilli, and 10 tical of salt	Rohu Labeo / Nga myit chin	Freshwater	Remove the head and guts of the fish. Wash fish multiple times until water is clear. Drain by using a strainer. Slice the fish into smaller sizes. Grind chilli with electric grinder. Add fish and salt into the grinder. Put it in the plastic big bag (7 viss) and keep it in the container and cover it. After 1 month, grind the fish paste mixture for the second time. Once paste is smooth, it can be sold.
002 KT	Shan Nga pi (Ki par)	Above 12000 MMK	Kengtung, Eastern Shan	Fish, salt, garlic and chili	12 viss of fish, 90 tical of chili, 90 tical of salt, and 2 cups of garlic (uses milk tin can).	Rohu Labeo / Nga myit chin	Freshwater	Wash the fish with salt and water. Drain the water using a strainer and sundry about 2 hours. Grind the fish, dried chili powder, salt and garlic together in electric meat grinder for 3 times. Put it in the big plastic bag. Keep it for 15 days during summer period or 1 month during winter period before selling. The fish paste must be kept in a refrigerator to extend shelf-life.

Sample number	Common/ Traditional name of the product	Price of products per viss	Production area	Main ingredients	Proportion of ingredients	Type of fish/shrimp species used	Source of fish	Method of production
003-NS	Nga Chin /Pazun Chin (Fermented Fish/Prawn)	Between 2000 and 3500 MMK	Nyaung Shwe	Fish, cooked rice, and salt	For every 2 viss of the finished product, it has 25 tical of fish, 5 tical of salt, 5 tical of garlic, and 1 tical of dried chili. Brown rice is equivalent to 6 tin cups uncooked rice	Spotted barb/Nga Khone ma	Freshwater	Boil brown rice and let it cool. Remove head, guts and scales of the fish. Wash the fish then soak in brine solution and keep for one night. Chop the fish. Pound the garlic. Mix cooked brown rice, fish, salt, and garlic. Once mixed, put it in the bamboo basket and press it by using a weight. Add the chili on top of the mixture. Press it again using a weight. Keep for two nights before selling.
004-NS	Nga Chin /Pazun Chin (Fermented Fish/Prawn)	Between 2000 and 3500 MMK	Nyaung Shwe , Southern Shan	Fish, cooked rice, garlic, chili, and salt	6 tical of fish, 1 tical of chili, salt and garlic.	Tilapia	Freshwater	Boil brown rice and let it cool. Remove head, guts and scales of the fish. Wash the fish and soak fish in brine solution. Pound the garlic. Slice the fish in smaller sizes. Mix cooked brown rice, fish and salt. Once evenly mixed, put the mixture in the bamboo basket and put chilli on top of the mixture. Cover with leaves and pressed it using a weight.

Sample number	Common/ Traditional name of the product	Price of products per viss	Production area	Main ingredients	Proportion of ingredients	Type of fish/shrimp species used	Source of fish	Method of production
005-SL	Ye gyo Ngapi (Fish paste)	Between 5501 and 8000 MMK	Salin, Magway	Fish, salt and roasted rice powder	0.85 viss (1 pyie) of fish 1 tin cup of salt 2 tablespoons of roasted rice powder	Nga Wat Ma (local name)	Freshwater	Clean fish by gutting and descaling. Put in a basket, add salt and roasted rice powder. Drain to remove excess water for 6-8 hours. After draining, transfer the mixture to a big terracotta pot. Press using a stone weight. Cover the pot using a cloth. After 2 months, the fermented fish can be sold.
006-SL	Ye gyo Ngapi (Fish paste)	Between 5501 and 8000 MMK	Salin, Magway	Fish, salt and roasted rice powder	1 pyi of fish (equivalent to 2.2 kgs) 1 tin cup of salt 2 tablespoons of roasted rice powder	climbing perch	Freshwater	Clean fish by gutting and descaling. Put in a basket, add salt and roasted rice powder. Drain to remove excess water for 8 hours. Mix fish, rice powder and salt on the tray. Once mixed, put it in the big terracotta pot and cover with cloth.
007-YGN	Ye gyo Ngapi (Fish paste)	Between 3501 and 5500 MMK	Yangon	Fish, salt, and cooked rice	Not known	Gourami	Freshwater (from Ayeyawardy)	The specific production for this sample is not known but he is aware that there are two methods of production; A. Short process of production 1) Fish and salt are put in a container for 2 days. The mixture of fish and salt is pressed (100 viss fish and 20 viss salt). 2) Cooked rice (hot) is added to fish and salt mixture. Then mixed. Store for one month before selling. Shelf life 1-2 months. B. Longer process of production 1) Fish and salt are put in a container for 1 month. The mixture of fish and salt is pressed (100 viss fish and 40 viss salt). 2) Before adding cooked rice (not hot), the salt is removed. Then add rice to the fish and salt mixture. The process is for 3-6

Sample number	Common/ Traditional name of the product	Price of products per viss	Production area	Main ingredients	Proportion of ingredients	Type of fish/shrimp species used	Source of fish	Method of production
								months before it is ready for sale. Shelf life is 1 year. Fish are washed, then salt is added; not gutted and descaled
011-ND	Ye gyo Ngapi (Fish paste)	Between 10001 and 12000 MMK	Nyaung Don, Ayeyawardy	Fish, salt, and cooked rice	10 viss of fish, 2 viss of salt, and 2 tin cups of broken rice	Climbing perch/Nga Bye ma Striped snakedhead/ Nga Yant Other species specify.	Freshwater	Soak the fish in the water for 1 day until it is soft. Grind the fish to turn it into small pieces Wash multiple times and drain to remove excess water. Add the salt and drain. Put it in a big terracotta pot and press using a weight. Keep it for 1 year. After a year take out the fishpaste from the pot and mix the cooked broken rice.
009-MKN	Ye gyo Ngapi (Fish paste)	Above 12000 MMK	Myitkyina, Kachin	Fish and salt	1 viss of fish, 10 ticals of salt	Torfish(Kyauk nga lu)	Freshwater	Clean the fish by removing the gut, then sun dry for 2 days. Afterwards, add salt and grind. Keep it in the plastic container/ big bamboo stick/leaf. Keep it in the box for 2 days, then it is ready to eat.
010-MKN	Nga Chin /Pazun Chin (Fermented Fish/Prawn)	Above 12000 MMK	Myitkyina, Kachin	Fish, salt, and cooked rice	20 viss of fish, 30 ticals of salt, cooked rice equivalent to 2 tin cups of uncooked rice	Rohu Labeo / Nga myit chin	Freshwater (From Yangon region)	Remove the head, gut and scales of the fish. Wash 3 times and drain it. Debone and slice the fish into small pieces. Separately, boil the rice and put it aside. Put fish in the container (5 gallon size paint container), add salt and boiled rice. Mix the ingredients thoroughly and then press the mixture using a weight. Keep it for 3 days before selling.

Sample number	Common/ Traditional name of the product	Price of products per viss	Production area	Main ingredients	Proportion of ingredients	Type of fish/shrimp species used	Source of fish	Method of production
015-SL	Ye gyo Ngapi (Fish paste)	Between 5501 and 8000 MMK	Salin, Magway	Fish and salt	1 pyi of fish (equivalent to 2.2 kgs) 1 tin cup of salt	Climbing perch/Nga Bye ma	Freshwater	Clean the fish by gutting and descaling. Put it in the basket and add salt and drain it for 1 day. After draining, mix fish and salt together and put it in the big terracotta pot and press using weight and covered the pot with cloth.
012-ND	Ye gyo Ngapi (Fish paste)	Between 5501 and 8000 MMK	Nyaung Don, Ayeyawardy	Fish, salt, and cooked rice	Fish 1 viss 50 ticals Fishpaste 150 viss broken rice 12 tin cups (3.3kg approx..)	Spotted barb/Nga Khone ma Indian glassy fish/Nga zin zat Mola: mola carplet/Nga bel phyu Snakeskin gourami / Nga pyin sa lat	Freshwater	Clean the fish, add salt and mix it. Drain it under the sun. Keep it in the pot for at least 6 months. Cooked broken rice and let it cool. Take out the fishpaste from the pot. Mix cooked rice and fishpaste. Keep it again in the new pot for 2 weeks.
008-YGN	Ye gyo Ngapi (Fish paste)	1800MMK per viss	Yangon	Fish and salt	8 viss of variety of fish (mostly by catch marine fish), 2 viss of freshwater fish (e.g. Mystus) and salt (unknown quantity)	Variety of marine fish (by catch)	Marine (from Ayeyawardy region)	The processor buy marine fish from San Pya fish wholesale market and jetties. Before grinding the fish, it is mixed with salt and drained for a day. Add salt to the fish. Then grind and drain it for 3 days. The vendor buy mixed fishpaste from the processor and adds a different batch of fishpaste with different fish species (Mystus). Once mixed, the product can be sold.

Sample number	Common/ Traditional name of the product	Price of products per viss	Production area	Main ingredients	Proportion of ingredients	Type of fish/shrimp species used	Source of fish	Method of production
013-WL	Ye gyo Ngapi (Fish paste)	Between 3501 and 5500 MMK	Wetlet, Sagaing	Fish, salt and roasted rice	1 viss of fish, and 35 tical of salt	Spotted barb/Nga Khone ma Indian glassy fish/Nga zin zat Climbing perch/Nga Bye ma Mystus /Ngazayaing, Tilapia	Freshwater	The fish is cleaned by gutting and descaling first. The fish is put it in the basket, salt is added. Then drain it for one night to ferment. Afterwards, it is kept in the pot for 2 weeks. After 2 weeks, it is sun dried for 1 or 2 days. Roasted rice powder is added. It is kept in the big terracotta pot for several months before it is sold.
014-MDY	Ye gyo Ngapi (Fish paste)	Between 3501 and 5500 MMK	Madaya, Sagaing	Fish, salt, and roasted rice powder	10 viss of fish, 1.5 viss of salt and 10 tical of roasted rice powder	Climbing perch/Nga Bye ma Spotted barb/Nga Khone ma Indian glassy fish/Nga zin zat Mystus /Ngazayaing Snakeskin gourami / Nga pyin sa lat	Freshwater	The fish is cleaned by gutting and descaling first. The fish is put it in the basket, salt is added. Then drain it for one night to ferment. Afterwards, it is kept in the pot for 2 weeks. After 2 weeks, it is sun dried for 1 or 2 days. Roasted rice powder is added. It is kept in the big terracotta pot for several months before it is sold.

6.2 Photos of selected samples

Figure 3. Fish paste from Salin.

Figure 4. Fermented fish (mixture of cooked rice and fish)

Figure 5. Fermented fish (mixture of cooked rice and fish) from Kachin.

Figure 6. Fermented fish (mixture of cooked rice and fish) from Nyaung Shwe.

Figure 7. Fish paste in Kengtung.

Figure 8. Fermented fish (mixture of cooked rice and fish) from Inle lake.