Factors Affecting Pricing of Skipjack Tuna and Sprats Dried Fish Value Chains in Sri Lanka

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ABSTRACT

Price is identified as the signal of the product indicating its availability in the market. Frequent price fluctuations adversely affect manfacturing industry performances including dried fish. Besides, dried fish prices fluctuate following the seasonality of fresh fish. However, several factors affect dried fish pricing other than seasonality. Thus, this study attempts to unravel the factors that affect dried fish prices with special reference to large pelagic skipjack tuna and small pelagic sprats. Matara and Jaffna districts were selected as the origin of the two value chains due to the abundance of the selected varieties respectively. Quantitative data collection approaches were adopted including a questionnaire survey with 80 processors, 70 wholesalers and 80 retailers by using simple random and snowball sampling techniques. Secondary data were gathered from Hector Kobbekaduwa Agrarian Research and Training Institute and the Department of Census and Statistics. Descriptive and inferential methods as coefficient of correlation, Wilcoxon sign rank test and ANOVA were used for the analysis. Value additions, imported product prices and market types significantly affected the pricing of skipjack tuna (Mean>3.93) and sprats (Mean>3.68) dried fish (p=0.00) through the value chain. Packing (p=0.00) and grading (p<0.00) products on colour, texture and size significantly affect the price changes of both dried fish value chains. Packing skipjack tuna (30%<) and sprats (40%<) dried fish indicate the significant (p=0.00), the highest percentage of price increment while white/yellow colour skipjack tuna (5%<) and dark colour sprat (5%<) products indicate the significant (p<0.00) highest percentage of price decrease. A weak correlation (r=0.35**) is noticeable between imported and local sprats than skipjack tuna (r=0.95**). Different market types including fair, store, grocery and supermarket significantly affect pricing for both dried fish products (p>0.00) except the wholesale market for skipjack tuna (p=0.068). The paper identifies the level of value addition, market types, presence of imports, and product-based characteristics as important determinants of pricing of small and large pelagic dried fish. However, these price determinants exhibit irregular and controversial relationships thus further research, dried fish policy and sector reforms on dried fish prices are needed.

KEYWORDS: Average prices, Dried fish, Value chain

Introduction

The price of a commodity is determined by the buyers and sellers (Chen et al., 2019). It is the result of the free market forces of demand and supply (Formentini et al., 2011).

However, the government may occasionally manipulate the pricing systems to make goods affordable to the poor (Sambuo et al., 2021). The value chain is a business model that explains the entire process of creating a product or service. A value chain is the sequence of processes that a company takes to get a product from conception to distribution, including the procurement of raw materials, production, operations, and marketing activities (Mandal, 2021). Determination of pricing in the value chain is critical in establishing the effective allocation of resources in a market economy (Chen et al., 2019). Pricing serves as a signal for shortages and surpluses, allowing enterprises and consumers to adjust to changing market conditions through value chain activities (Sambuo et al., 2020). Rising prices discourage demand and motivate enterprises to strive to expand supply. When a product is in excess, its price tends to plummet (Kim, 2018). Falling prices encourage individuals to buy and prompt transactions through the value chain to strive to cut back on supply (Mandal, 2021).

Dried fish pricing methods serve an important economic role (Chang and Su, 2022; Kim, 2018). It is not arbitrarily regulated; offers an economic mechanism for distributing dried fish products to the enormous number of consumers who want them (Faruque et al., 2012). It also serves as an indication of the strength of demand for dried fish products, allowing producers to respond appropriately. This method is known as the dried fish pricing mechanism, and it is founded on the concept that only allowing prices to vary freely would supply equal demand for any particular product (Sambuo et al., 2020). Further, dried fish prices are very important to monitor industry development and perform the market function properly in a particular country (Adenegan and Bolarinwa 2010). Moreover, prices act as a sign of the relative scarcity or abundance of a given product. Prices also serve as an incentive to direct the allocation of economic resources to determine the structure and the rate of economic growth (Adenegan and Bolarinwa, 2010).

Imported dried fish (MFARD., 2020), seasonal variation of fish production (Murray and Little, 2000), value addition techniques (Koralagama et al., 2021), marketing methods (Khileri et al., 2015) and market monopoly (Sambuo et al., 2021) are identified as the main price determination factors of different dried fish products. Moreover, consumers purchasing behaviour as well as prices of dry fish are varied on the different quality parameters such as colour, taste, variety and market type other than a seasonal variation of production (Pradhan et al., 2017). Low-income persons prefer to purchase low priced dried fish products and high-income people prefer to purchase high priced products from the market (Islam et al., 2020).

There are big price differences between imported dried fish varieties and local dried fish varieties in Sri Lanka (MFARD., 2020). Local produce varieties are comparatively more expensive than imported dried fish varieties. Regardless, profit margins for local market varieties are lower than the imported dried fish varieties available in the Sri Lankan market (Murray and Little, 2000; Weerahewa and Kodithuwakku, 2013).
The availability of low-cost, imported dried marine fish means that it is still the key replacement for local varieties in different markets (Hossain and Masud, 2012). The prices of dried fish are highly sensitive to the production variation of fish.

Due to the seasonal variation of fish production, dried fish prices are changed (Murray and Little, 2000; Wickrama et al., 2021). There are higher prices in lean dried fish production season than in peak production season (Murray and Little, 2000) following the supply and demand concept. Lengths of the supply chain and value addition are identified as other major price determination factors of the dried fish (Faruque et al., 2012). Dried fish prices are doubled when moving dried fish via a long supply chain from producers to retailers (Hossain et al., 2015). There are critical differences in prices across geographical areas, recommending an inefficient and unregulated marketing system, where the influences of intermediaries are significant (Weerahewa and Kodithuwakku, 2013). Marketing strategies are identified as another major factor which affects dried fish pricing. Marketing methods are differed from area to area and from dried fish variety to variety in Sri Lanka (Koralagama et al., 2021). Small fish and dried fish varieties of low price are more likely to be sold by small-scale bicycle vendors to poorer customers in remote villages, whereas high price varieties are bulked for sale by motorcycle vendors in and around rural villages in Sri Lanka (Khileri et al., 2015). During the dry season, the highest numbers of merchants enter the market and the individual dried fish selling volumes are highest as the result of intensified competition for market shares (Murray and Little, 2000).

Information on current dried fish price variation patterns and how they are likely to change on different value addition techniques are required to identify the consumer buying behaviors, development of economic policies, contribution to the market structure, conduct and performance of the dried fish market in Sri Lanka (Thu et al., 2021; Koralagama et al., 2021). Efficient price information may help to increase production and producers are likely to produce more if they can sell at reasonable prices (Hatali and Soosaimanickam, 2018). The efficient prices stimulate consumption as consumers are ready to buy more if they can purchase their requirements in the right form, place, time and at a minimum satisfaction (Adenegan and Bolarinwa, 2010).

However, the efficient price information is not transmitted to the producers and traders through the marketing channel as a result of processors' lack of specialization to competitive advantage (Jensen, 2007). Potential gains from the trade are not achieved (Mafimisebi, 2011; Abila, 2003). Determinations of relevant pricing mechanisms for changing different value-adding techniques are a gap to console between processors, wholesalers, retailers and the government (Sambuo et al., 2021). The informal prices and demand changes affect the industry performance (Nor et al., 2020), affecting both processors (Nor et al., 2020) and rural consumers (Braha et al., 2018), where both ends are marginalized. Research on dried fish value additions and pricing is lacking in developing countries like Sri Lanka (Koralagama et al., 2021). Therefore, this study was designed to examine the factors affecting sprats and skipjack tuna dried fish pricing and to identify the significant relationship among each selected factor.

Methodology

This study was carried out on the South and North coast of Sri Lanka representing two major dried fish production districts Matara and Jaffna taking into account a large amount

of skipjack tuna (*Katsuwonus pelamis*) dried fish and sprats (*Stolephorus sp.*) production district in Sri Lanka (MFARD., 2020). This study was mainly conducted through major two dried fish varieties representing the highest per-capita and household consumption large pelagic and small pelagic dried fish varieties in Sri Lanka (DCS, 2019). The general methodology adopted in this study comprises an analytical phase. Detailed individual interviews were carried out with dried fish value chain actors in each area by using a pre-tested structured questionnaire to collect primary data.

Simple random and snowball sampling methods were used to select well-experienced 80 processors, 70 wholesalers and 80 retailers representing sprats value chain in Jaffna and skipjack tuna value chain in Matara district by using available processors' name list in fisheries association, traders association, fisheries office and divisional secretary office in each area. The primary data were collected mainly on skipjack tuna and sprats dried fish price variation, value chain actors' perception of different highly abundant value-added techniques such as grading, sorting and packing, imported products and different market types.

Secondary data was collected mainly through Hector Kobbekaduwa Agrarian Research and Training institute (HARTI) weekly and monthly price bulletin from 2017-2021 for imports and local dried fish products. Other than Household Income and Expenditure data from the Department of Census and Statistics (DCS), books, magazines, articles, newspapers and websites to identify the main investigation criteria and other related information. Both qualitative and quantitative data were analyzed using descriptive statistics and inferential analysis methods such as paired t-test, coefficient of correlation, Wilcoxon sign rank test and ANOVA. Percentage price (Rs./kg) variation of value-added products compare to non-value added products was calculated by using equation [1]. It was derived by using the methods of Wickrama et al. (2022) and Hosken and Reiffen (2004) in their price variation study. Mean prices of each graded, sorted and packed dried fish were considered as the value added product price and mean prices of full size normal dried fish were considered as non-value added product price for the analysis through the equation [1].

$$\begin{array}{l} Percentage \\ price \ variation \end{array} = \frac{Value \ added \ product \ price - Nonvalue \ added \ product \ price}{Nonvalue \ added \ product \ price} \qquad [1] \\ * 100\%$$

Results and Discussion

Table 1 indicates the results of the Wilcoxon sign rank test for identifying producer, wholesaler and retailers' perceptions toward different factors affecting for price variation of skipjack tuna dried fish.

Value additions, imported products and market types are mainly affecting the skipjack tuna dried fish price variation. From these three factors, processors indicate that value addition especially colour and packing are mostly affecting the pricing mechanisms of skipjack tuna while the market types are the least affecting factor. Wholesalers denote

that value addition especially colour and texture are the highest impact factor for skipjack tuna pricing while market types are the least affecting factor. Retailers indicate that packing is the highest impact factor while market types are the least impact on the pricing of skipjack tuna dried fish. Furthermore, the Wilcoxon sign rank test denotes that all the factors significantly affect producer, wholesaler and retailer levels pricing of skipjack tuna (see tables 3 and 4 for value-adding criteria).

Table 1: Different Factors Affecting Skipjack Tuna Dried Fish Pricing

Factors/ Levels		Processor		Wholesaler		Retailer	
		Mean	p-value	Mean	p-value	Mean	p-value
Value additions	Colour	4.26	0.00	4.2	0.00	4.25	0.00
	Size	4.06	0.00	4.0	0.00	4.25	0.00
	Texture	4.04	0.00	4.2	0.00	4.05	0.00
	Packing	4.13	0.00	4.06	0.00	4.35	0.00
Imported products		4.02	0.00	3.93	0.00	4.05	0.00
Market types		3.93	0.00	3.8	0.00	3.8	0.00

Note:Significant level a=0.05) (1-5 Likert scale, 1-the least important/ 5-the most important

Table 2 reveals the Wilcoxon sign rank test results for identifying the perception of dried fish value chain actors toward sprats pricing. Sprats' processors and wholesalers indicate that value additions especially colour and packing mostly affect the pricing while retailers indicate that texture is the most important factor which affects sprats pricing. The sprats' processors, wholesalers and retailers reveal that market type is the least affecting factor for the sprats pricing. The sign test results denote that all the factors significantly affect sprats pricing at producer, wholesaler and retailer levels (see tables 3 and 4 for value-adding criteria).

Table 2: Different Factors Affecting Sprats Dried Fish Pricing

Factors/ Levels	Processor		Wholesaler		Retailer	
	Mean	p-value	Mean	p-value	Mean	p-value

Value additions	Colour	4.26	0.00	4.26	0.00	4.3	0.00
	Size	4.02	0.00	4.06	0.00	4.25	0.00
	Texture	4.02	0.00	4.13	0.00	4.35	0.00
	Packing	4.13	0.00	4.13	0.00	4.3	0.00
Imported products		4.08	0.00	4.06	0.00	4.05	0.00
Market types		3.93	0.00	3.73	0.00	3.8	0.00

Note:Significant level a=0.05) (1-5 Likert scale, 1-the least important/ 5-the most important

There are different types of research conducted in Bangladesh, India and Nigeria by mentioning the significant impact of value addition (Haque et al., 2015; Bhuyan and Goswami, 2013; Shamsuddoha, 2007), market types (Brummett, 2000; Ghorai et al., 2014).), length of the supply chain (Haque et al., 2015; Shamsuddoha, 2007), imports products (Liverpool-Tasie et al., 2018), exports, marketing methods for fish and dried fish prices (Hossain et al., 2015).

The next sections discuss the relationship of the significant impact of the above-selected factors on the pricing of skipjack tuna and sprats by using inferential analysis of secondary and primary data.

Value Additions
Table 3 illustrates paired t-test results for different value-added techniques and related criteria with the mean price variation of each product for skipjack tuna dried fish. There are different types of grading practices based on the colour, texture and size of dried fish parts. Other than that, value chain actors practice packing of production as a value addition technique. There are major 03 products based on colour red/pink, white-red mix and white/yellow colour. Based on the texture, major 02 types of dried fish grades are identified as hard and soft. According to the size, there are major 04 grades as full, halves, broken and blocked portions (10-15g). Packing and blocked portions are the highest expensive products at all three levels as processors, wholesalers and retailers level of the skipjack tuna dried fish value chain. Other than that red/pink colour products are indicated as the highest value through the value chain. White/yellow colour skipjack tuna dried fish at processor level; soft products at wholesaler and retailer level are identified as the least value products in skipjack tuna dried fish value chain. The paired t-test value revealed that there is a significant impact on value addition toward price increment for most of the value-added products of skipjack tuna dried fish.

Grading Technique	Criteria	Processor		Wholesaler		Retailer	
		Mean price (Rs.)	P-value	Mean price (Rs.)	P-value	Mean price (Rs.)	P-value

Colour	Red/pink	630	0.00	800	0.00	1075	0.00
	White-red mix	515	0.00	695	0.00	980	0.00
	White/yellow	468	0.00	618	0.00	910	0.00
Texture	Hard	568	0.00	745	0.00	1020	0.00
	Soft	505	0.00	655	0.00	905	0.00
Size	Full	510	-	685	-	960	-
	Halves	510	-	680	0.00	955	0.00
	Broken	495	0.00	670	0.00	940	0.00
	Blocked portion (10-15g)	668	0.00	845	0.00	1100	0.00
Packing		990	0.00	1100	0.00	1350	0.00

Table 3: Value Addition Criterion, Prices and Significant Levels for Skipjack Tuna Dried Fish

Note:Significant level a=0.05

Figure 1 reveals the value additions and percentage price variation of skipjack tuna at producer, wholesaler and retailer levels for different value-added products.
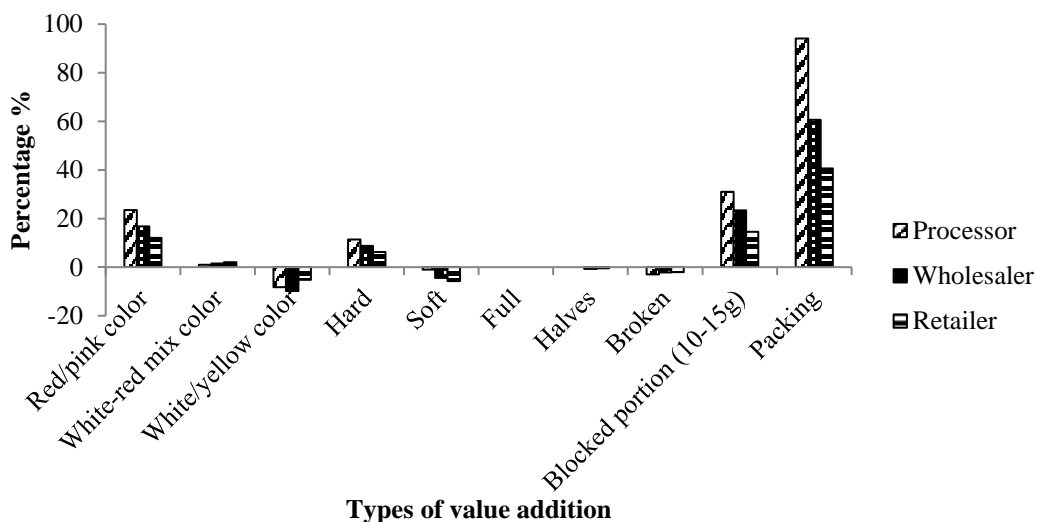

Figure 1: Value Additions and Percentage Price Variations of Skipjack Tuna Dried Fish

The highest percentage price increase is indicated that packing dried fish products at all three skipjack tuna dried fish value chain levels comparatively normal/non-value added products prices. White/red mix colour products indicate the least percentage price increase while broken and white/yellow mix colour skipjack tuna dried fish products

indicate the price decrease comparatively normal/non-value added products at all the three value chain actors level.

Table 4 reveals paired t-test results for different value-added techniques and related criteria with mean price variations of each product for sprats dried fish. There are different types of grading practices based on the colour, texture and size of dried fish parts. Other than that, value chain actors practice packing of production as a value addition technique. There are major 03 products based on the colour as gold, white and dark colour. Based on the texture, major 02 types of dried fish grades are identified as hard and soft. According to the size, there are major 03 grades as full, broken and de-headed. Packing and de-headed products are the highest expensive products at all three levels of the sprats dried fish value chain. Other than that gold colour products are indicated the highest value through the value chain. Dark colour products are identified as the least value products at all processor, wholesaler and retailer levels of sprats' value chain. Further, paired t-test values reveal that there is a significant impact on value addition toward price increment for most of the value-added products of sprats.

Table 4: Value Addition Criterion, Prices and Significant Levels for Sprats Dried Fish

Grading technique	Criteria	Processor		Wholesaler		Retailer	
		Mean price (Rs.)	P-value	Mean price (Rs.)	P-value	Mean price (Rs.)	P-value
Color	Gold	1100	0.00	1290	0.00	1520	0.00
	White	980	0.00	1150	0.00	1380	0.00
	Dark	880	0.00	1080	0.00	1280	0.00
Texture	Hard	1000	0.00	1200	0.00	1410	0.00
	Soft	900	0.00	1100	0.00	1290	0.00
Size	De-headed	1200	0.00	1450	0.00	1680	0.00
	Full	905	-	1100	-	1320	-
	Broken	900	0.00	1090	0.00	1320	0.00
Packing		1350	0.00	1600	0.00	1850	0.00

Note:Significant level a=0.05

Figure 2 reveals the value addition and percentage price variations of sprats at producer, wholesaler and retailer levels for different value-added products

Figure 2: Value Additions and Percentage Price Variations of Sprat Dried Fish
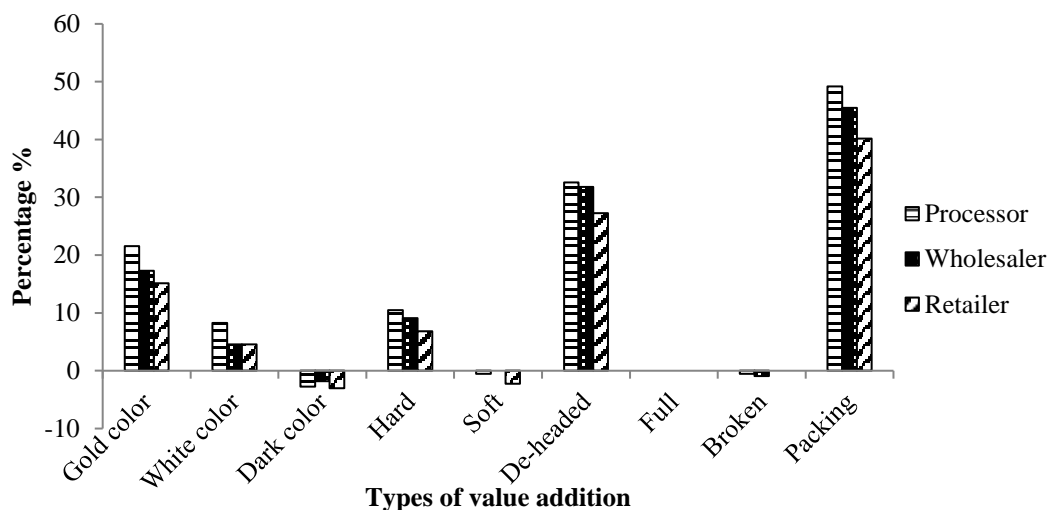
The highest percentage price increase is indicated for the packing dried fish products at all the three sprats dried fish value chain level comparatively non-value added/normal products prices. De-headed products indicate the second largest price increment while gold colour products indicate the third largest. Dark colour, soft and broken sprats dried fish products indicate the price decrease comparatively normal/non-value-added products at all the three value chain actors levels.

Value chain actors sell their value-added dried fish products at a higher price to gain the highest profit than normal products (Mandal, 2021). The value-added dried fish products are sold at high prices through the dried fish value chain in Bangaladesh (Haque et al., 2015). There are different types of dried fish value-added products in the Bangladesh dried fish market (Bhuyan and Goswami, 2013), and profitability and price are not as high as normal products as the value- added products (Shamsuddoha, 2007). It revealed that value additions are mainly important to increasing the price of dried fish products (Hossain et al., 2015).

Price of Imported Products
Figure 3 illustrates the average monthly mean price variations of imported dried fish and local dried fish during 2017-2021.
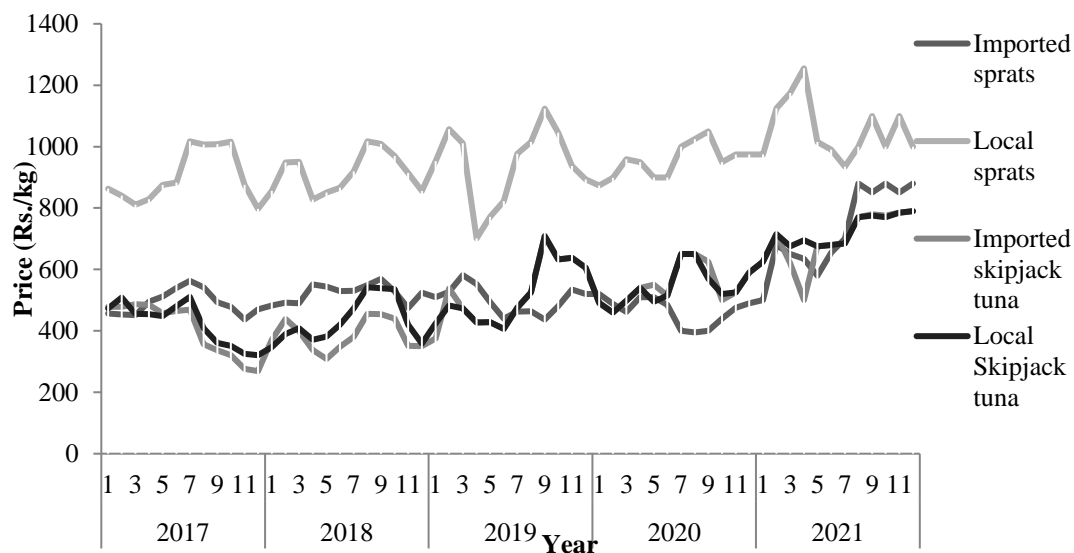
Figure 3: Price Variations of Imported and Local Dried Fish

There is the same pattern of price variation between imported sprats and local sprats as well as imported skipjack tuna and local skipjack tuna. There is a considerable price difference between imported dried fish and local dried fish, especially in sprats. Local skipjack tuna indicates that Rs. 15/kg mean price or 2.89% of price increase comparatively imported skipjack tuna. Further local sprats indicate that Rs.412.72/kg mean price or 76.25% price increase comparatively imported sprats.

Table 5 illustrates that coefficient of correlation of imported and local skipjack tuna and sprats dried fish prices. There are significant positive relationships between each imported and local skipjack tuna and sprats dried fish varieties. A positive weak significant relationship is identified between imported sprats and local sprats while a positive strong relationship is identified between imported skipjack tuna and local skipjack tuna.

Table 5: Coefficient of Correlation of Imported and Local Dried Fish Prices

Correlations	Imported Sprats	Local Sprats	Imported Skipjack Tuna	Local Skipjack Tuna
Imported sprats	1	.35**	.58**	.64**
Local Sprats		1	.53**	.64**
Imported skipjack tuna			1	.95**
Local Skipjack tuna				1

*Note:** Significant level a=0.05*

More than 38% of dried fish products are imported to Sri Lanka from different countries (MFARD., 2020) while sprats and skipjack tuna are identified as major imported dried fish varieties (DCS, 2019). More than 70% of sprats and a significant amount of skipjack tuna are imported by different countries like Thailand, Iran and India to fulfill local consumption (Koralagama et al., 2021). Therefore, there can be identified a significant correlation between local and imported dried fish product prices.

Income and price changes indicate that imported fish and dried fish are deeply consumed by Nigerian people due to the low price. Further, Nigerian consumers are keen to consume fresh fish as incomes increase, and the demand for smoked and dried fish also remains strong at high levels of income (Liverpool-Tasie et al., 2021). Currently imported frozen fish prices are much higher than fresh domestic fish or the fresh equivalent prices of dried fish in Africa. These findings reveal that imports of dried fish product prices affect to determine local product prices and consumption patterns in most countries (Liverpool-Tasie et al., 2018).

Market Types

Figure 4 illustrates the wholesale and retail price variations of skipjack tuna and sprats at different market levels.
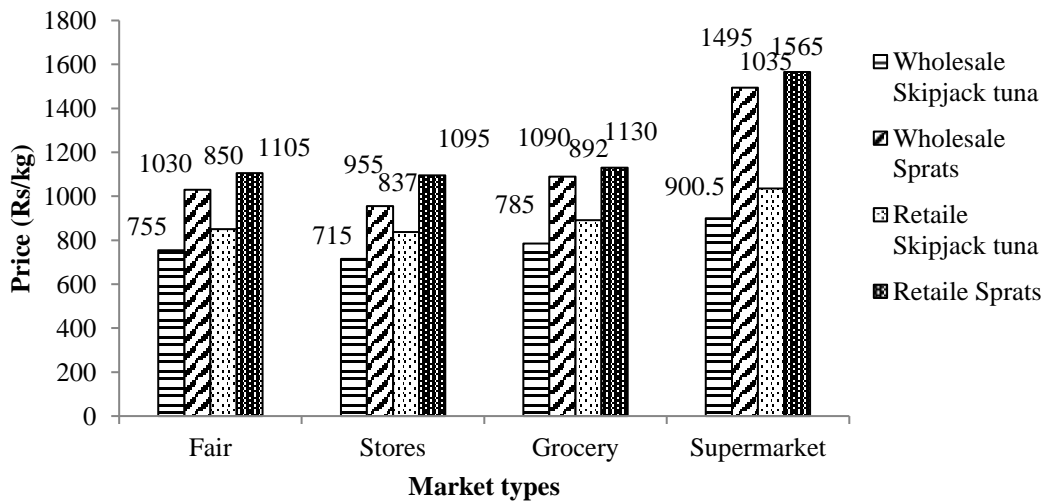

Figure 4: Different Market Types and Mean Price Variations of Dried Fish

There are the highest wholesale and retail prices of skipjack tuna and sprats at the supermarket level comparatively fair, store and grocery. The lowest retail and wholesale skipjack tuna and sprats dried fish prices are identified in stores such as specified dried fish selling shops. They mostly sell only dried fish. As mentioned in table 6, there are significant differences between wholesale and retail prices of skipjack tuna and sprats at different marketplaces.

Table 6: ANOVA Analysis for Dried Fish Price Variations at Different Types of Market

Dried Fish Variety	Value Chain Levels	F Value	Significance Value
Skipjack tuna	Wholesale	2.95	0.07
	Retail	16.95	0.00
Sprats	Wholesale	121.56	0.00
	Retail	92.48	0.00

There are higher prices and higher profits for dried fish at the supermarket level in Bangladesh (Shamsuddoha, 2007). There are different dried fish markets in Bangladesh as supermarkets, grocery, export market, etc. High-valued dried fish products are mainly produced by targeting the export markets while other low price products go to the local retail market via wholesalers for domestic consumption (Hossain et al., 2015). The average prices are significantly higher in urban than in rural markets in Southern Malawi (Brummett, 2000; Mandel, 2021). It revealed those dried fish prices differ from market to market in most countries like Bangladesh and India (Ghorai et al., 2014).

Conclusions

This study was designed to examine the factors affecting dried fish pricing with special reference to sprats and skipjack tuna. Grading based on the product quality such as size, colour and texture; packing, availability of imported products and market types significantly affected the pricing of both skipjack tuna ($\bar{x}>3.93$) and sprats ($\bar{x}>3.68$). Value additions such as cut pieces into 10-15g blocked portions and packing report a significant impact on pricing ($p=0.00$). The impact is significant ($p=0.00$) for sprats concerning de-headed sprats. A weak correlation ($r=0.35**$) is noticeable between imported and local sprats than skipjack tuna ($r=0.95**$). Different market types including fair, store, grocery or supermarket affect pricing for both dried fish products ($p>0.00$) except the wholesale market for skipjack tuna ($p=0.068$). This study claims for more value additions to gain higher prices. A significantly higher impact was enforced by imported skipjack tuna, however, the influence of imported sprat on local was mild. This might be due to the larger quantity of imported sprats available in the domestic markets. In contrast, the level of impact differs from factors to factors hence unpredictable and difficult to bring onto a model. In essence, it is consultable that product-based qualities, level of value additions, market types, and availability of imported products heavily effect on dried fish pricing mechanism. This calls for further research, dried fish policy and sector reforms on dried fish prices are needed.

Acknowledgement

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