

## Status of Fisheries Postharvest Industry in the Sultanate of Oman: Part 3. Regression Models of Quality Loss in Fresh Tuna Fish

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**Abstract:** One of the problems limiting the profitability and competitiveness of the fisheries sector in Oman is the high incidence of losses at the landing sites and other stages in the postharvest marketing chain. Our previous studies indicated that cool-chain management in the Omani fresh fish industry was generally inadequate given that freshly landed fish may be exposed to high air temperatures of over 40 °C for up to 5-7 h duration during retail display in unshaded areas. As a result, losses in both quantity (physical) and quality are an economic problem. In the present study, we modelled the reduction in fresh fish quality based on the decline in value (price) to the customer over the marketing period. For large pelagic fish, downgrading of quality through price reduction is limited to 2-3 days after landing, following which the fish is discarded (waste) or processed into secondary fish products such as *maleh*. Our findings showed that reduction in fish value due to loss of freshness can reach up to 10-25% after the first day of landing and 19-44% after the second days of landing. Using data on reductions in fresh fish price due to quality loss as perceived by fishers and marketers in the Muscat Governorate, we present regression models on the chronological decline in the Omani tuna value during postharvest handling and marketing at major landing sites. The implications of these findings on postharvest handling and supply chain management of fresh fish in Oman are discussed.

**Key words:** Postharvest handling, fresh fish, quality loss, tuna, regression models, oman

### INTRODUCTION

The Sultanate of Oman is endowed with abundant and diverse range of fisheries and other seafood resources. With its long coastline (over 3000 km, Fig. 1), the economies of many coastal communities have flourished in fisheries business. Over eighty percent of the Omani fisheries sector is dominated by traditional fisherman. Tunas, mainly yellowfin and longtail tuna are major fisheries resources of Oman (Fig. 2) and are highly sought after by local and export markets. Fresh tunas are often handled by several operators in the supply chain before delivery to the consumer, including fishermen, onsite retailers, offsite retailers, middlemen, small scale processors and large scale processors. The range of postharvest handling steps contributes to the high incidence of losses. In an earlier paper we quantified the levels of fish losses in a selected fish markets in Oman<sup>[1]</sup>.

Recent nationwide estimates indicated that loss in quantity (thrown away) from commercial fishing ships

ranged between 40-70% for demersal fish and up to 5% for large pelagic fish (mainly tunas), while quantity loss by traditional fishermen amounted to over 10% of actual landings. In addition, annual loss in value due to downgrade in fish quality was estimated to worth nearly RO 24 million (US\$ 62 million)<sup>[2]</sup> High incidence of losses in quantity and quality of harvested fish is therefore a major obstacle that limits the realization of the economic potential of the fisheries sector in Oman. The contribution of tuna fish to the total traditional landings and fish values in Oman has continued to decrease (Fig. 2). Given the significant importance of tuna in the Omani fisheries sector, the objective of our study was to quantify the loss in value experienced by fishermen and retailers. Using data on reductions in fresh fish price due to quality loss as perceived by fishers and marketers in the Muscat Governorate, we present regression models on the chronological decline in the Omani tuna value during postharvest handling and marketing at major landing sites.

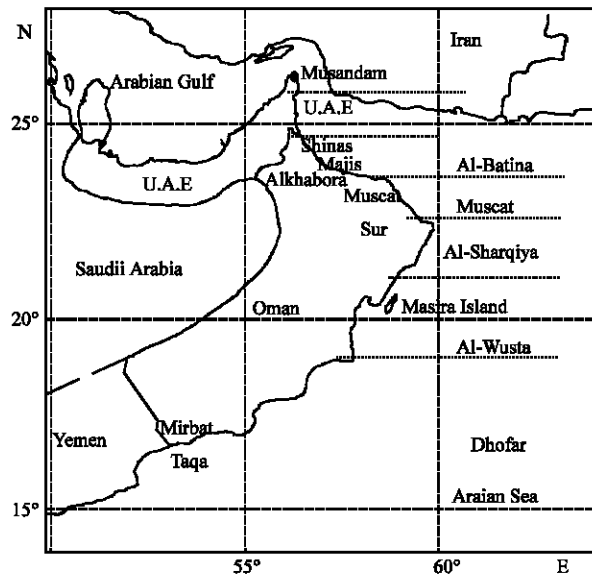


Fig. 1: Map of Oman showing the coastal fishing areas

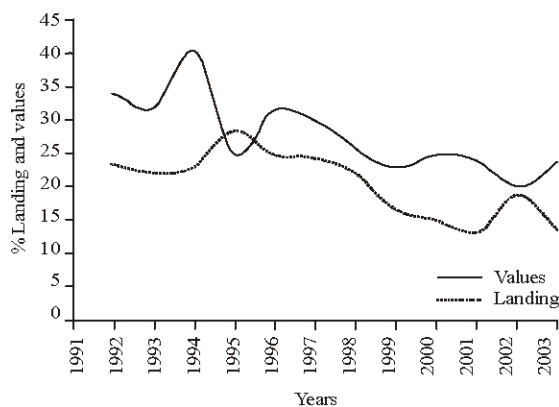


Fig. 2: Percentages of contribution of total tuna landings and values to the total traditional fishery in Oman during the period 1991-2003 (data source: MAF 2003).

## MATERIALS AND METHODS

A structured questionnaire was developed and used to study the postharvest handling systems and incidence of losses of fresh tuna at three major landing sites and fish markets in Muscat Governorate, Oman. Fishers and marketers were surveyed individually or in small groups of two or three. Details of the research methodology have been reported earlier<sup>[1-3]</sup>. The survey data on reductions in unit price of fresh fish species reported by fishermen and retailers were used for the regression analysis. A minimum of 20 fishers and marketers were surveyed.

## RESULTS AND DISCUSSION

**Observations on tuna quality loss:** The way fresh fish are displayed in the fish markets increases the value loss of the fish itself. The majority of the tuna sold at the landing sites are displayed for a period of up to 5-7 h on the beach, with air temperatures often ranging from 25 to 40°C (and higher during the summer). Handling and displaying fish under the extreme environmental conditions result in increase in the microbial activity which accelerates fresh fish spoilage and increase in histamine levels<sup>[4-5]</sup>. It is common practice for fishermen and retailers to spray the produce periodically with cold fresh or seawater to maintain freshness. The unsold tunas are usually stored in ice flakes for maximum three days after which they are processed into *maleh* or discarded<sup>[3]</sup>. Whole fish that remained unsold on the third day after landing were cut and sold in small portions. Alternatively, the unsold whole fishes or pieces are processed into *maleh* (cut, cleaned and preserved with large amount of salt).

**Quality assessment and pricing determination:** We observed that fresh tuna fish were sold per piece based on a combination of visual (subjective) assessment of size and freshness. Fish freshness was commonly assessed using of a range of subjective assessments including smell, hand feel (rubberiness), eye color and changes in gill color. Table 1 shows the price reductions of three sizes of tuna fish due to delay in marketing and related quality loss. Small size tunas are usually the 'longtail' tuna while the medium and large ones are 'yellowfin' tuna. We noted that fishers and retailers do not normally reduce the unit price of tuna on the day of landing and particularly during the early morning hours, presumably when the freshness is maximum.

**Regression modelling:** Regression models of fresh tuna quality (value) loss due to delay in marketing are shown in the Fig. 3 and 4. Price reduction due to loss of freshness was the same for small and medium tuna fish, but higher than large tuna. Analysis of cumulative loss in value (price) showed a price reduction of up to 30-35% for all fish sizes if they were not sold during 2 days after landing. These prediction models provide valuable tools for action-oriented training and stakeholder sensitization in efforts to reduce the prevailing high incidence of losses through the adoption of improved handling and management practices. Our finding have shown that under the current postharvest handling and marketing practices, fresh tuna fish have a maximum shelf life of three days, during which there is a rapid loss in quality and value. Literature evidence suggests that with proper

Table 1: Price of fresh tuna fish (RO per piece) as affected by size during marketing at the landing sites.

Day	Small tuna	Medium tuna	Large tuna
1 (landing)	2.000*	6.000	10.000
2	1.500-1.800	4.500-5.400	8.000-9.000
3	1.000-1.600	3.000-4.800	6.000-8.000

\*Rial Omani (RO) = 0.386 USD

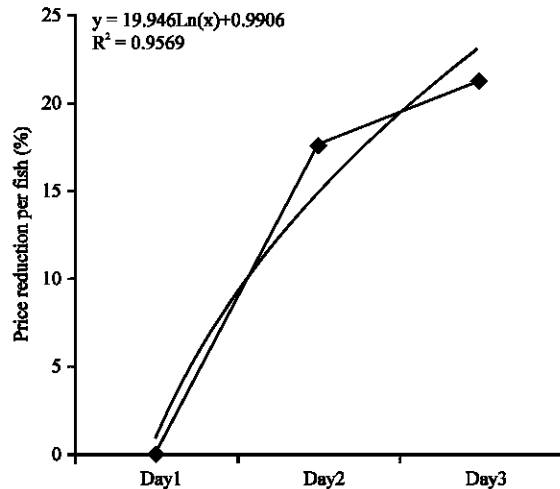


Fig. 3: Mean daily loss (%) in value of small/medium size fresh fish from of landing

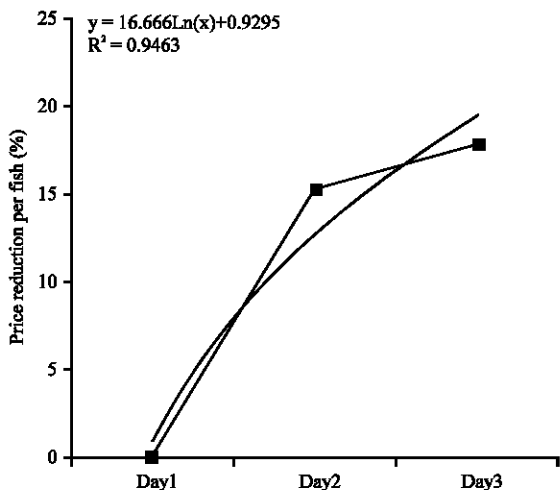


Fig. 4: Mean daily loss (%) in value of large tuna fish from day of landing

handling and application of modern cool chain technologies, this short period could be extended up to more than 10 days<sup>[1,4,6]</sup>.

## CONCLUSION

Observations made at fish landing sites and traditional markets in the Sultanate of Oman indicated that fresh tuna quality deterioration can be attributed mainly to inadequate postharvest handling practices, including poor cool chain maintenance. This results in a short shelf life of about three days and downgrading of the product. Price reduction for small and medium tuna was higher than those for large tunas. Regressions models of daily reductions in unit price of fresh tuna were presented based on survey data obtained at major landing sites in the Muscat Governorate. Overall, the results of this study highlight the potential of enhancing both the shelf life and price of tuna in the traditional fish markets in Oman through the adoption of improved handling and cool chain management practices.

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