

# Facts about shelf life of packaged loins

The shelf life of saltfish and clipfish is influenced by storage conditions such as temperature, relative humidity, and packaging. Also, the water content and the initial level of halophilic microorganisms of the fish influence its shelf life.



Storage at 4 °C (left) gives a shelf life of a minimum of 2 years. In the case of storage at elevated temperatures (e.g., 25, 30, or 35 °C (right), a red discoloration may appear due to the growth of halophiles.

## 1 What is a red discoloration?

- Red discoloration of salt- and clipfish is caused by the growth of halophiles (extreme halophilic microorganisms) such as *Halobacterium* and *Halococcus*.
- Halophiles require air to grow.
- Optimal growth conditions occur at salt concentrations from 20 to 26% NaCl and at temperatures in the range from 35 to 41 °C.
- Below 8 °C, no growth of halophiles occur, but they survive.
- A minimum of 10,000,000 halophiles per gram product is required to obtain red discoloration visible to the human eye.
- The red discoloration is considered to be a quality defect (Codex Standard for salted fish and dried salted fish of the gadidae family of fishes. Codex Stan, 167–1989).

## 2 Is it safe to consume salt- or clipfish with a red discoloration?

- Although classified as a quality defect, the visible red discoloration due to growth of halophiles on salt- and clipfish are considered harmless and do not affect food safety of salt- and clipfish.

## 3 Where do the halophiles originate from?

- Halophiles are naturally occurring in sea- and rock salt.
- During the salting process, the halophiles are transferred to the fish.
- Halophiles are unevenly distributed in the salt, thereby unevenly distributed on the fish surface and within a fish batch.

## 4 What promotes the growth of halophiles?

- Water content. The high water content of the product promotes the growth of halophiles and thus shortens shelf life.
- Humidity. Products stored at 60% relative humidity (RH) obtain a longer shelf life than those stored at 80% RH.
- Temperature. Products stored at 25 °C have a longer shelf life than those stored at 35 °C. In case of storage at 4 °C, the clipfish has a shelf life of minimum 26 months.

## 5 What is the shelf life of packaged loins?

Shelf life is defined as the minimum number of days the loins can be stored before red discoloration appears. The shelf life of packaged saltfish and clipfish loins stored at 25, 30, and 35 °C at 60 and 80% RH varies (Figure 1). In the case of storage at 60% RH, moisture is transported away from the product, while at 80% RH, moisture is transported into the product.

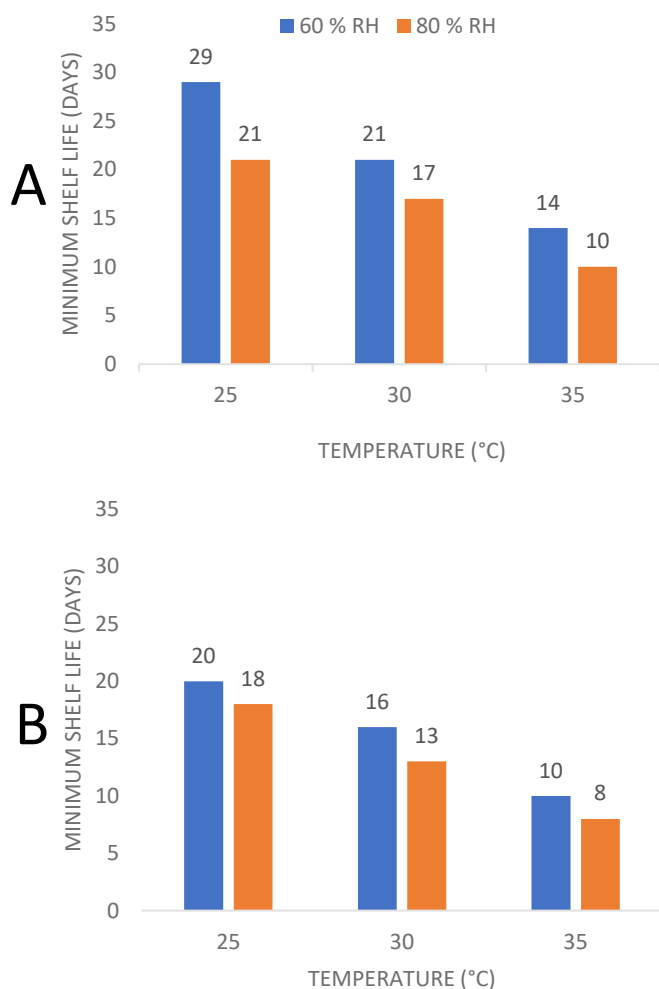


Figure 1. Minimum shelf life (days) of packaged saltfish and clipfish loins stored at 25, 30, and 35 °C. The loins' initial water content was 50% (A) and 54% (B). At the start, the initial level of halophiles was 1000/g in all the products.

For example, packaged loins with an initial water content of 50%, stored at 80% RH and at 30 °C, have a shelf life of a minimum of 17 days. Furthermore, packaged saltfish loins with an initial water content of 54%, stored at 60% RH and at 35 °C, have a shelf life of a minimum of 10 days.

## 6 What is a brown discoloration?

- Brown discoloration of salt- and clipfish is caused by the growth of a fungus, e.g., *Wallemia sebi*. This discoloration is commonly termed as "dun".
- The fungus is dispersed as spores in the air.
- The fungus requires air for growth.
- Storage of the fish at light or dark conditions does not influence the growth.
- The fungus is xerophile/osmophile, and thereby able to grow at salt levels from 5 to 26%.
- Growth occurs from 5 to 37 °C, with optimum growth from 20 °C to 25 °C.
- A fish showing an aggregated area of pronounced clusters of the brown discoloration on more than 1/3 of the total surface area of the face side is considered defective (Codex Standard for salted fish and dried salted fish of the gadidae family of fishes. Codex Stan, 167–1989).

## 7 Labeling of shelf life

Packaged food products must be labeled with a shelf life, either with an "expiration date," which is related to the food safety. Alternatively, a "best before" date which is related to the quality attributes of the product. As saltfish and clipfish with visible red or brown discoloration do not affect food safety, labeling with a "best before" date is appropriate. Products labeled with a "best before" date can be sold after this date. In such a cases, the shop should consider products with appropriate quality.

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