

Facts about shelf life

Shelf life is affected by temperature, relative humidity, water content, packaging and the initial level of halophiles.



Storage at 4 °C (left) gives a shelf life of minimum 2 years. When stored at elevated temperatures (e.g. 25, 30 or 35 °C (right), a red discoloration appears due to growth of halophiles.

1. What is red discoloration?

- Red discoloration of salt- and clipfish is due to growth of halophiles (extreme halophilic microorganisms) such as *Halobacterium* and *Halococcus*.
- Optimal growth conditions include a salt concentration of 20 to 26 % NaCl and temperature between 35 and 41 °C.
- Below 8 °C, no growth occurs, but the halophiles survive.
- Requires air for growth.
- Very high numbers of halophiles are required to obtain a visible red discoloration.
- Minimum 10.000.000 halophiles per gram product is the limit for visual red discoloration.
- Red discoloration is considered to be a quality defect.

2. Is it safe to consume?

- Halophiles in salt- and clipfish are harmless and do not affect food safety.

3. Where do the halophiles come from?

- Halophiles are naturally occurring in solar and rock salt.
- During the salting process, halophiles are transferred to the fish.
- Halophiles are unevenly distributed in the salt, and thus, unevenly distributed on the fish or even within a batch of fish.

4. What promotes growth of halophiles?

- Water content. A high water content of the product promotes growth of halophiles and thus shortens shelf life.
- Humid conditions. Products stored at 60 % relative humidity (RH) have 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.

5. What is the shelf life of packaged loins?

Shelf life of packaged saltfish loins stored at 25, 30 and 35 °C at 60 and 80 % RH varies (figure 1). In

case of storage at 60 % RH, moisture is transported away from the loins, while at 80 % RH, moisture is transported into the loins. Shelf life refers to the minimum number of days the loins can be stored before red discoloration appears.

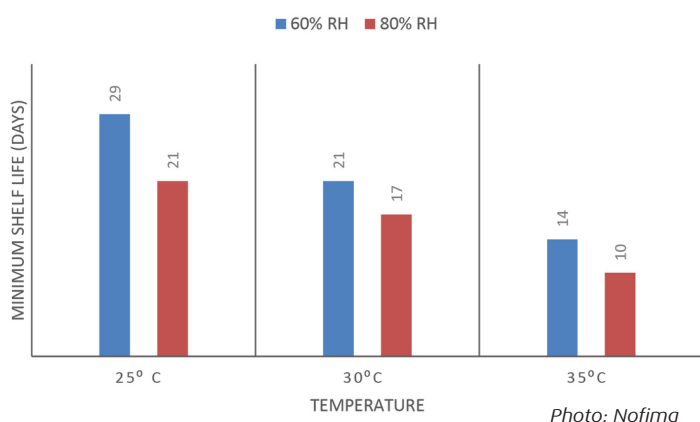


Figure 1. Minimum shelf life (days) of packaged saltfish loins stored at 25, 30 and 35 °C. Water content of the loins was 50 % at start and initial level of halophiles was 1000/g product.

For clipfish with 48 % water stored at 80 % RH at 30 °C, shelf life is *minimum* 17 days.

6. Shelf life of Norwegian split saltfish and clipfish stored at 4 °C:

- The shelf life is *minimum* 2 years when stored at 4 °C in waxed cardboard boxes.
- For split saltfish and clipfish packaged in the same way as loins (picture), the shelf life will be equal to packaged loins when stored at elevated temperatures.
- Preliminary studies indicate that shelf life of split saltfish and clipfish without any packaging differs from packaged products.

7. What is the level of halophiles in Norwegian split saltfish and clipfish?

Natural occurring levels of halophiles causing red discoloration in salt- and clipfish are very low, typically 10 halophiles/g product, while the maximum level analysed is 1000. If stored at elevated temperatures, the initial level of halophiles is decisive for shelf life. This can be analysed by following this procedure:

- Randomly select five sample units from a lot.
- If the sample unit is a carton, randomly select one fish from each carton.
- Store at 80 % RH at 25, 30 or 35 °C (use no carton or package).
- If red discoloration appears *before* 18, 10 or 8 days, respectively, the initial level of halophiles is above 1000/g.
- If red discoloration appears *after* 18, 10 or 8 days, respectively, the initial level of halophiles is below 1000/g.

8. What is brown discoloration?

- Brown discoloration of salt- and clipfish is due to growth of halophilic mould (dun).
- The mould is present in the air, and is dispersed as spores to the fish.
- Requires air for growth.
- Storage under light or dark conditions do not affect growth.
- The mould is halophilic, and growth occurs at a salt level between 5 and 26 %.
- Minimal growth at 4 °C. Grows well at 20 °C to 25 °C, and barely at 30 °C.
- A fish showing an aggregate area of pronounced halophilic mould clusters on more than 1/3 of the total surface area of the face side is considered to have a quality defect.

The research has been conducted in the project "Holdbarhet på klippfisk" (Project number 900856) financed by FHF.

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