

# Rainbow trout

What should we know?

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**Species tool**

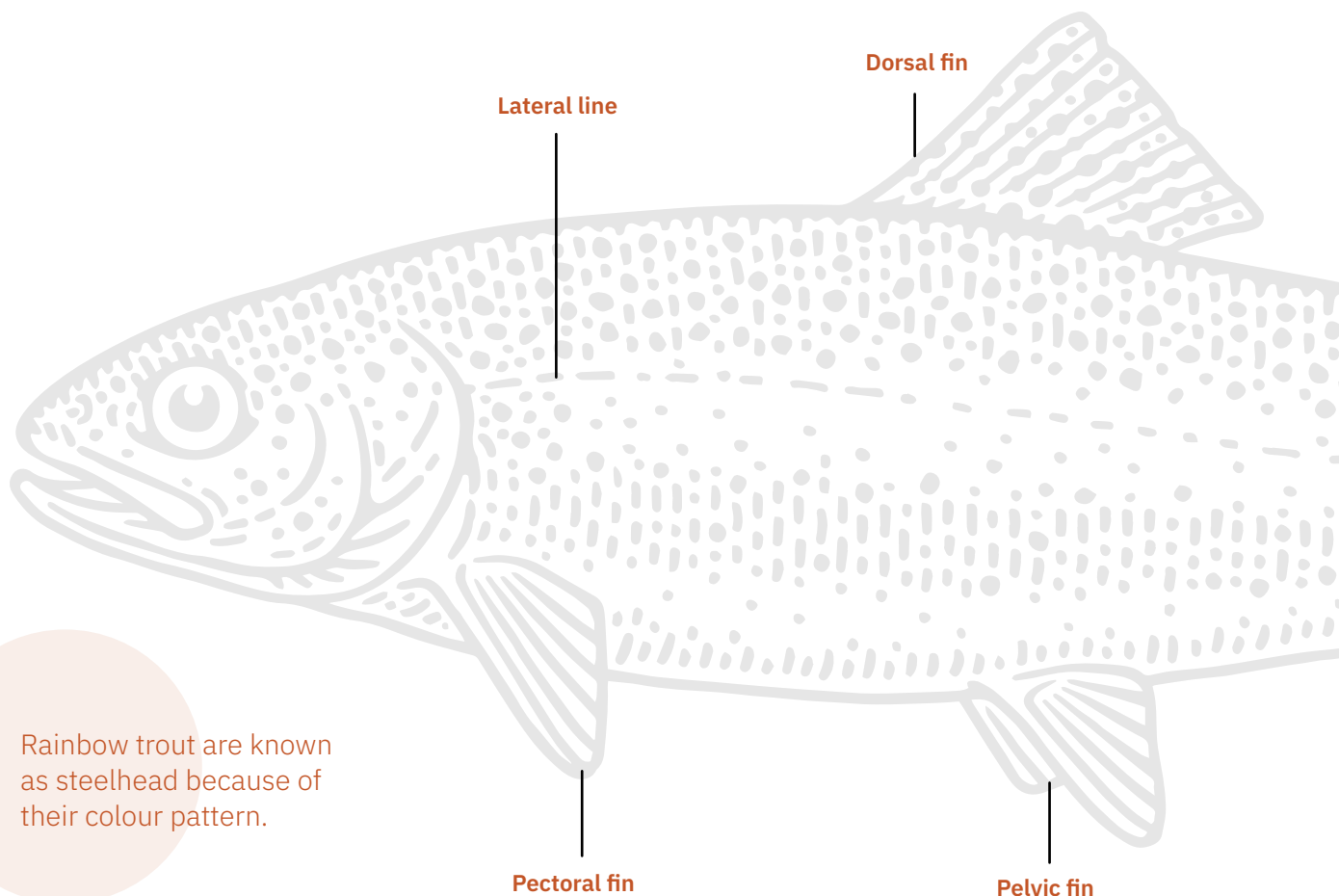
# Rainbow trout:

## What should we know?

Trout comprise three genera — *Salmo* (Atlantic species), *Oncorhynchus* (Pacific species) and *Salvelinus* — all of which belong to the subfamily of the *Salmoninae*, which falls under the family of the Salmonids. The brown trout (*Salmo trutta*) belongs to the *Salmo* genus, the rainbow trout (*Oncorhynchus mykiss*) belongs to the genus *Oncorhynchus* and the Arctic char (*Salvelinus alpinus*) is part of the *Salvelinus* genus. Interestingly, the Salmonid family has two more subfamilies, the *Coregoninae* and the *Thymallinae*. The European white fish (*Coregonus lavaretus*) is a genus that falls under the *Coregoninae*, while the grayling (*Thymallus thymallus*) belongs to the *Thymallinae*.

Several of the above species are used for aquaculture and are commonly farmed in many colder parts of the world. Trout are cold-water fish and need water of excellent quality rich in oxygen. The most widely farmed trout species is the rainbow trout, native to the western part of North America. Because this species is very suitable for aquaculture, rainbow trout were distributed to other parts of the world and farmed for the table and stocking waters for angling purposes.

Rainbow trout are torpedo-shaped fish with a dark grey/green back and silvery sides dotted with small black spots that run onto the fins. The belly is whitish in colour. This camouflage pattern serves them well in the crystal-clear gravel-bottomed streams in which they often live. As they get older, especially when they mature, they can have a pinkish stripe across the lateral line. Rainbow trout are carnivorous and eat aquatic insects and their larvae, crustaceans, terrestrial insects, amphibians and small fish. This trout species can survive in waters with temperatures of 1–24°C, while their optimum water temperature for fast growth is 16°C. Rainbow trout are anadromous fish, which means that the adults will migrate to the sea, if possible, to feed. They are then known as steelhead because of their colour pattern. When they return to their native river, they are large, silvery fish that are ready to spawn. In outdoor farming, rainbow trout can grow from first feeding to 350 g in about 12–18 months normally. However, under constant, optimal conditions, like in RAS facilities, the growth cycle to 350 g is 8–9 months.



Rainbow trout are known as steelhead because of their colour pattern.

# Other well-known trout species are:



## Brown trout

*Salmo trutta*

This species is also torpedo-shaped, with a small adipose fin. This fish varies in colour depending on the clarity of the water it lives in. In crystal-clear water, the brown trout is a silvery bronze with large dark spots, some red spots mixed in and silver bellies. In darker, peat-stained water, the brown trout has a dark brownish colour, again with large dark spots and some red spots. The water temperature for optimal growth lies around 14°C. Brown trout, like rainbow trout, are freshwater fish, but where they have access, part of the population will migrate to the richer feeding grounds in the sea. These fish are called sea trout and have a silvery appearance.



## Arctic char

*Salvelinus alpinus*

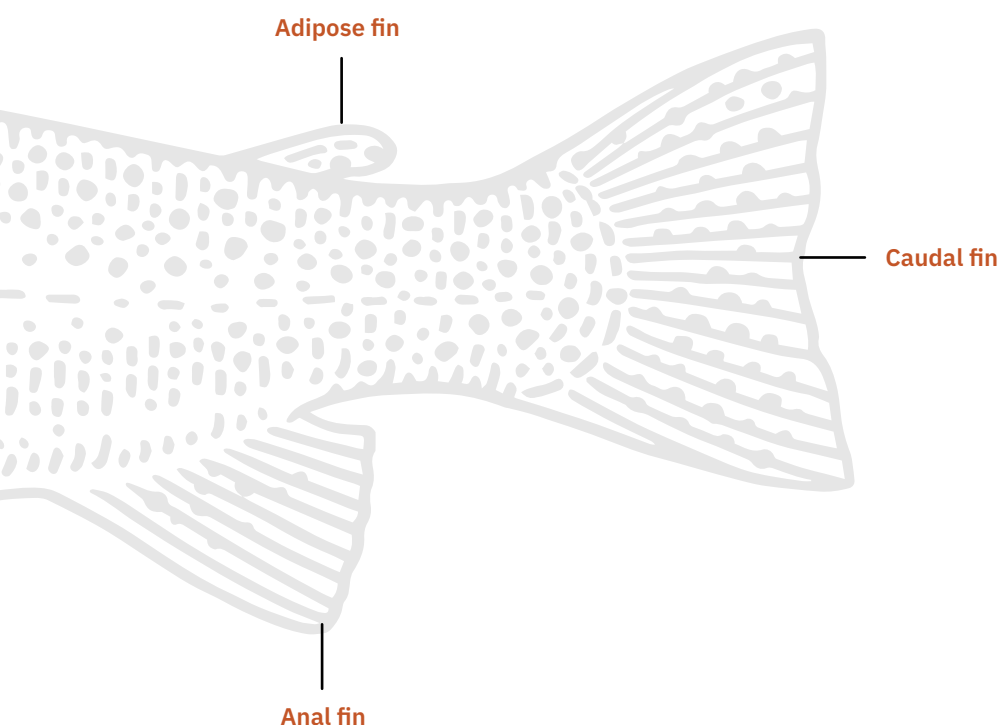
The Arctic char is native to alpine lakes and Arctic and Subarctic waters. No other fish species lives as far north as the Arctic char. With access to the sea, a part of the population will migrate in order to benefit from the richer marine feeding grounds. This beautiful fish looks rather similar to the brook trout but has a forked tail instead of the square tail that brook trout have. The Arctic char is greenish-brown, without the marbled appearance on the back as brook trout have, and they have small yellow spots on the sides. The lower fins also carry a white lining. Arctic char are very resistant to HVS and IHN but susceptible to furunculosis. This species can handle high stocking densities quite well. The optimum water temperature for growth is 12–13°C.



## Brook trout

*Salvelinus fontinalis*

This freshwater species has a greenish-brown colour with a marbled pattern on its back and lighter coloured sides. The sides are covered in red spots with a blue halo. The belly can be yellow to orange, and the lower fins have a distinctive white lining. This beautiful trout can grow a little faster than brown trout, but not as fast as the rainbow trout. Brook trout are quite resistant to HVS and IHN but susceptible to furunculosis. Brook trout need cold and oxygen-rich water, and their optimum water temperature lies around 12–14°C.



## Hybrid char or Sparctic char

*Salvelinus alpinus x Salvelinus fontinalis*

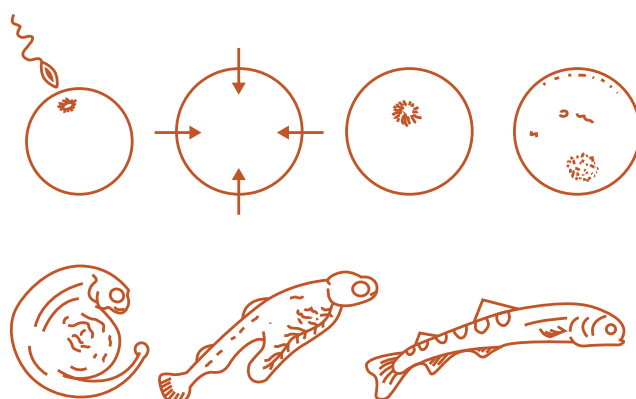
This hybrid is popular in aquaculture because of its resistance against some major viruses. This is a big advantage for farms that use river water, in which these viruses are endemic. It is a robust fish that grows well and combines the strong points of the parent fish. Sparctic char are known to be sexually mature and are capable of reproduction. For that reason, all-female or triploid fish are preferred.



# Trout farming

## Hatchery

In the northern hemisphere, trout reproduction takes place from October–March. The eggs can be stripped from October onwards, depending on the strain and conditions. The stripped eggs are fertilised and incubated until they hatch. The incubators can either be the traditional Californian tray incubator, a vertical tray incubator or an upwelling jar incubator. It takes about 300 degree days (30 days at 10°C) before the eggs of rainbow trout hatch. It takes another 200 degree days (20 days at 10°C) before the larvae have absorbed their yolk sac and are ready to eat. The larvae are then called swim-up fry, and they come up to the surface to swallow air to inflate their swim bladder. The larvae and fry require low light and are kept in dark or semi-dark conditions. The swim-up fry must be fed frequently with an adequate feed size so that all individuals can eat. Hygienic conditions are essential, and any faeces or uneaten feed that accumulates on the bottom of the troughs or tanks needs to be removed regularly. It goes without saying that the water quality should be excellent with sufficient oxygen. The water temperature in the hatchery is usually between 8–12°C. Most farms these days buy their trout eggs from specialised suppliers with broodstock selected to give the best results. Eggs are available as mixed-sex, all-female and triploid. The hatchery phase is usually from egg to 1–10 g per piece.



## Nursery

In the nursery phase, the fingerlings are kept in larger tanks or ponds, and they are usually grown on to about 50 g. Starter feeds and pre-grower feeds of 2 mm are used for this phase, especially. At the end of the nursery phase, the trout are quite robust and ready for the on-growing phase. Excellent conditions, again, need to be provided for the best results.



## Ongrowing

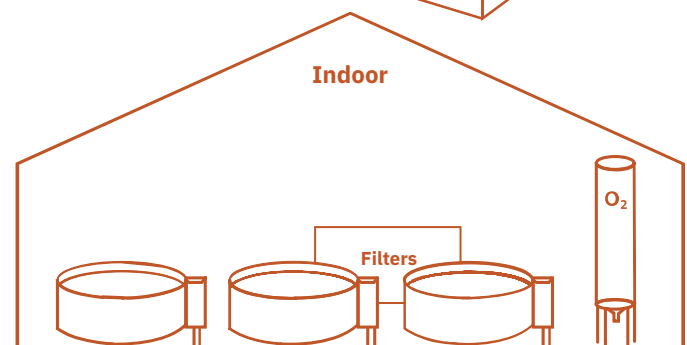
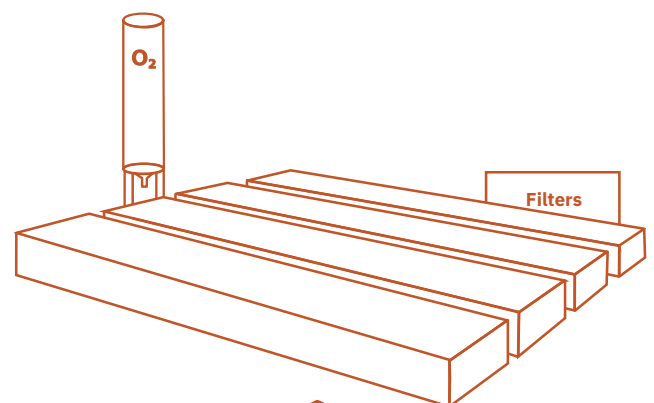
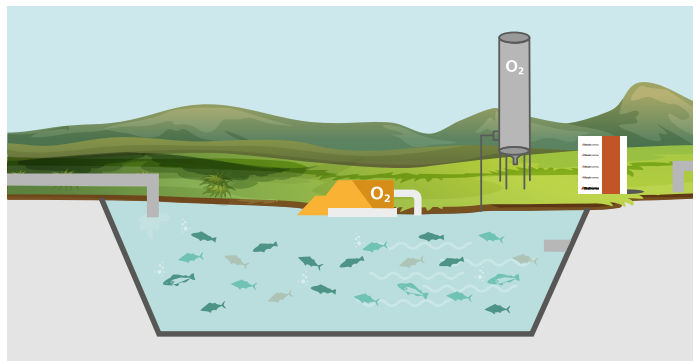
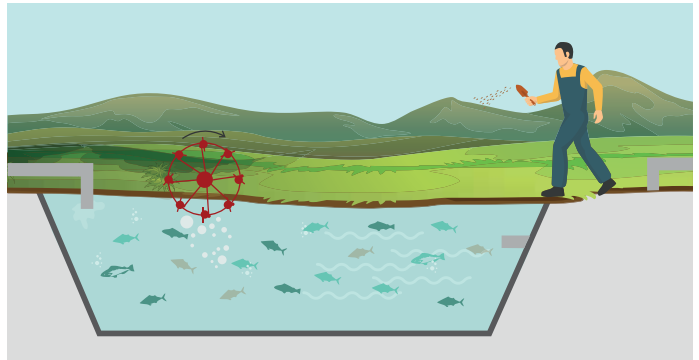
A large part of the trout market is for table-sized trout, which is about 350 g. Depending on the water temperature, which controls the feed intake, metabolism and growth rate, this can take 8–9 months when the water temperature is consistently optimal or 12–18 months when farmed outside, with the winter season severely slowing down growth or stopping it altogether. Other markets prefer larger trout up to 3 kg or more, often with pigmented flesh. Ongrowing can be done in earthen ponds, concrete raceways, rectangular or circular tanks, and cages. Trout farmed up to 3 kg or more are often farmed in seawater cages. Currently, more and more trout are farmed in outdoor and indoor RAS facilities, in which the water is filtered and reused.

In traditional freshwater farming, water from a spring or river is led through a series of ponds or raceways, after which it is returned to the river. The trout in the farm use the oxygen dissolved in the water, and the excrement flows into the river. The stocking density depends on the available oxygen in the water. Due to seasonal fluctuations in water flow, water temperature and oxygen level, productivity is restricted. These farms usually use low-energy diets because these work well in variable conditions.

Semi-intensive farming is characterised by aerating the water in some way to keep more fish and increase yearly production. It also helps to prevent naturally occurring oxygen shortages. In such farms, medium-energy diets are generally used. In intensive farming, liquid oxygen is used for full control over the oxygen level. In this type of farming, high stocking densities can be reached, as well as high yearly production. In this type of farm, medium-high and high-energy feeds are normally chosen for the best results.

In RAS facilities, filters are used to remove the excrement of the fish so that the water can be reused. The water is degassed and reoxygenated to provide consistent optimal conditions. RAS feeds, and skilful employees that understand the system well are required.

Trout have nice succulent meat with a lovely white colour. A part of the market prefers the pink colour for which salmon is known. By feeding feed with astaxanthin, trout also get a pink flesh colour that looks quite appetising.

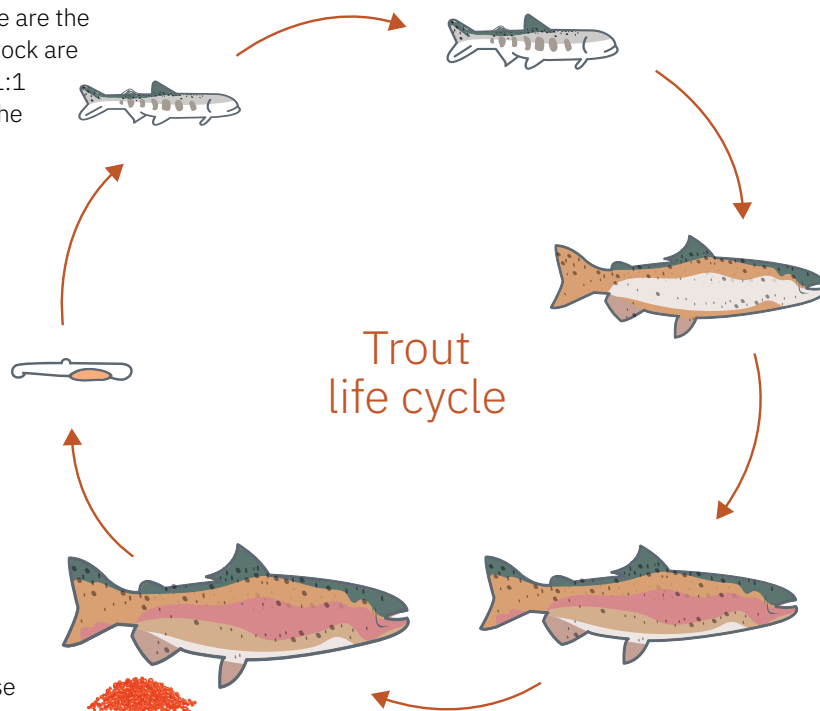


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## Broodstock

Some farms keep their own broodstock. These are the strains that do well on their farm. The broodstock are often kept together at a male:female ratio of 1:1 in shallow ponds or tanks. Other farms keep the two sexes separate. The densities are kept quite low — no more than 10 kg/m<sup>3</sup>. The shortening day length and dropping water temperature induce hormonal changes and prepare the trout for spawning from October onwards. By manipulating the photoperiod, the spawning season can be delayed and prolonged. The females mature at 2–3 years of age, while the males mature about one year earlier. One large female rainbow trout can give around 9,000 eggs with a diameter of 4–5 mm.

Specialised egg producers keep several strains, like early maturing strains for table trout production and late-maturing strains for when the harvest weight is 2 kg or more. These companies have selective breeding programs, whereby the broodstock are selected for traits like growth rate, FCR, disease resistance and early or late maturation. Such companies can provide mixed-sex population, all-female and triploid eggs. All-female populations grow quite evenly and lack the stress of early maturing males chasing the females. For producing 2–3 kg trout, either very late-maturing strains or sterile triploid stock with no maturation issues are used. Late maturing females eventually mature and lose some of the astaxanthin in their flesh as it is transferred into the eggs, with the flesh becoming less firm. This is undesirable and, thus, the fish must be harvested before they mature. Triploid stock have three chromosomes and are, therefore, sterile and do not sexually mature, produce eggs nor have any of the mentioned maturation issues.



Triploid eggs are produced by applying pressure or temperature shock during the fertilisation process, by which an extra chromosome is kept so that these eggs have three instead of the usual two chromosomes.

Broodstock are normally fed broodstock diets rich in protein and vitamins, as well as astaxanthin and a high concentration of the long-chain omega 3 fatty acids EPA and DHA.

## Harvest

Before harvest, the fish are starved for one or two days to make sure their digestive tract is empty. The harvested trout are then usually kept for 5–7 days in a purging tank or pond to make sure that any off-flavour in the flesh has disappeared.





# Commercial products

- Live for restocking
- Fingerlings for further on-growing
- Gutted, head-on fresh or smoked
- On-farm sales of fresh, smoked, marinated or grilled trout
- Oven-steamed trout with lemon juice and herbs
- There is a market for white and pigmented, pink-fleshed trout meat

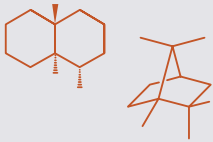


# Challenges in trout production



## Rainbow trout fry syndrome (RTFS)

This disease is quite common in hatcheries and is caused by the bacterium *Flavobacterium psychrophilum*. This bacterium is quite well spread and causes poor performance and mortalities.



## Off-flavour

Off-flavour is caused by geosmin and 2-methylisoborneol (MIB), which are produced by microorganisms like cyanobacteria and actinomycetes. These microorganisms thrive in conditions with a high amount of suspended solids stemming from faeces and uneaten feed. Off-flavour spoils the taste of the meat.



## Pathogenic problems

Pathogenic problems can cause poor feed intake and performance on farms.



## Optimal feed performance

Farmers strive to reach good growth rates and low FCRs. Fish performance is related to feed quality, farming conditions, stock health, genetics and farm management.



## Water availability

Due to increased water use by agriculture and the industry over the years, as well as climate change, the amount of water available to outdoor farming has decreased considerably, and there are more seasonable fluctuations.



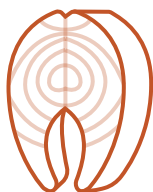


# Solutions:



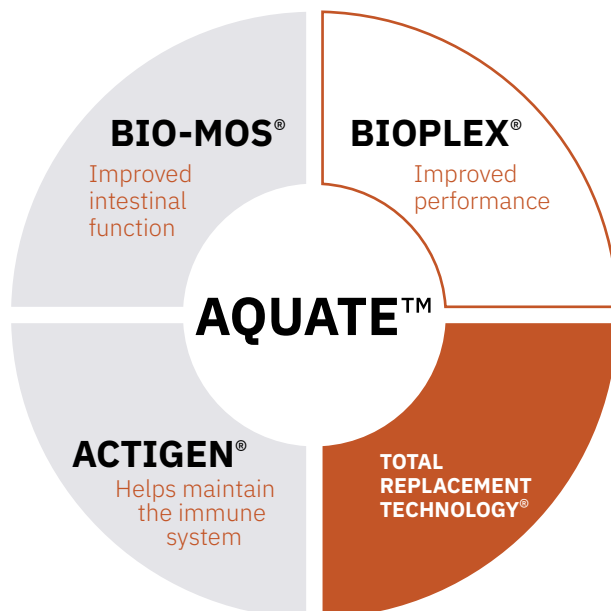
## Genetics & feed additives

Strains developed by specialised trout egg producers through genetic selection have a high resistance against RTFS caused by *Flavobacterium psychrophilum*. Alltech Coppens also produces Aquate®, which strengthens the mucus barrier protection of the skin, gut and gills.



## Purging

Purging is the main way of getting rid of off-flavour. The fish are not fed for one or two days prior to harvesting to empty their digestive tract. They are then transferred to clean tanks or ponds with clean water, where they lose any off-flavour. Through continuous water exchange, the geosmin and MIB are removed. Normally, after 5–7 days, the off-flavour has disappeared. It is also important to prevent unnecessary off-flavour build up. This can be done by keeping the tanks or ponds clean and, in RAS facilities, also the filter area.



## Aquate® health pack: Healthy growth from hatch to harvest

By incorporating Alltech's Aquate technology in our trout formulations, we nurture a healthy gut microbiome for optimal nutrient digestibility and boost fish health, ultimately contributing to better farm performance. Aquate contains yeast-based products such as Bioplex®, Bio-Mos® and Actigen®.

The inclusion of Aquate safeguards the healthy growth of this fish species, from hatch to harvest. Bio-Mos and Actigen within the feed premix preserve the microbial balance within the gastrointestinal system, ensuring improvement of the digestive system and nutrient absorption and utilisation. The inclusion of Bioplex chelated minerals also guarantee the efficient uptake of dietary micronutrients vital to building and developing a healthy skeletal structure and robust immune system.





## Optimal performance

Optimal performance starts with buying high-quality eggs or fingerlings from a reliable source. Excellent conditions are constantly needed, with sufficient oxygen for the fish to eat and digest the feed well. The right feed should be chosen to suit the farms' potential. Alltech Coppens offers a selection of low-energy, medium-energy, medium-high-energy, high-energy and RAS feeds to suit all types of trout farming. The feeding strategy is important too. It is crucial to feed the fish enough for a high growth rate and low FCR but not too much, which would lead to feed spilling. Uneaten feed only spoils the water quality. It is not just the feed amount given but also the speed at which the feed is administered. Trout need enough time to eat all the pellets before they hit the bottom. Checking that all the feed is eaten is a critical part of farm management. Alltech Coppens provides two feeding tables, one for a low FCR and one for optimal growth, that can be used as guides. However, the farmer's strategy, the appetite of the fish and the water parameters determine the actual feed rate.

Checking that all the feed is eaten is an important part of the farm's management.



## Biosecurity

Rainbow trout in aquaculture can be affected by a host of diseases and parasites. A very effective way to prevent disease issues as much as possible is to only buy eggs or fingerlings from certified disease-free suppliers. Good hygiene and disinfection measures throughout the whole farm also help to prevent the spreading of parasites and other pathogens. Bird nets are invaluable for keeping fish-eating birds out that are known to spread diseases, and these are compulsory for outdoor trout farming in some countries.





## Research & development

With 30 years of experience researching, developing and producing high-quality trout feeds, Alltech Coppens offers on-farm assistance through our dedicated sales team and technical support team, ensuring optimal farm performance.

Alltech Coppens formulates feed on the 4 Pillars of Fish Nutrition: **Palatability**, **Performance**, **Pollution Control** and **Planet**. All four pillars are important and taken into the balance of sourcing new/alternative raw materials:



### 1. Palatability

To ensure the best growth and performance of fish, optimal feed intake is vital. Fish must be attracted to the smell and taste of the feed.

### 2. Performance

Our feeds must perform well. This means that they must generate healthy growth and ensure efficient feed utilisation. This is a decisive factor in the profits of fish farmers.

### 3. Pollution Control

To maintain water quality and secure optimal fish health and performance, it is crucial that all our feeds are highly digestible, thereby decreasing the risk of pollution.

### 4. Planet

The environmental sustainability of the feed.





For more information, please contact us:

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