Successful from the start – Modern fry feeds for salmonids

Dr. Florian Nagel and Torben M. Nissen, Aller Aqua Research GmbH

Fry feeds play a crucial role in fish nutrition. For species that do not require live feed and can be directly accustomed to dry feed (such as rainbow trout), they represent the first external food source after the yolk sac stage. These critical first weeks of life, when the newly hatched fish are especially vulnerable to pathogens and experience rapid growth, require a high degree of care in selecting raw materials and ensuring well-balanced nutrient content. At the same time, fish farmers need to pay close attention, as regular feedings and consistently excellent water quality are essential.

Figure 1: Development of rainbow trout from hatching to dry feed adapted fish (size scaled, © Aller Aqua Research GmbH, Pictures: Marco Prütz)

Specific area of application – pellet size matters

Usually, feeds with pellet sizes of up to approximately 1.5mm are referred to as fry feeds, while pellets larger than 2mm are considered (pre-)grower feeds. The pellet sizes are chosen to provide an optimal nutrient profile depending on the fish's developmental stage. Figure 2 shows an example of the protein-to-fat ratio at different pellet sizes.

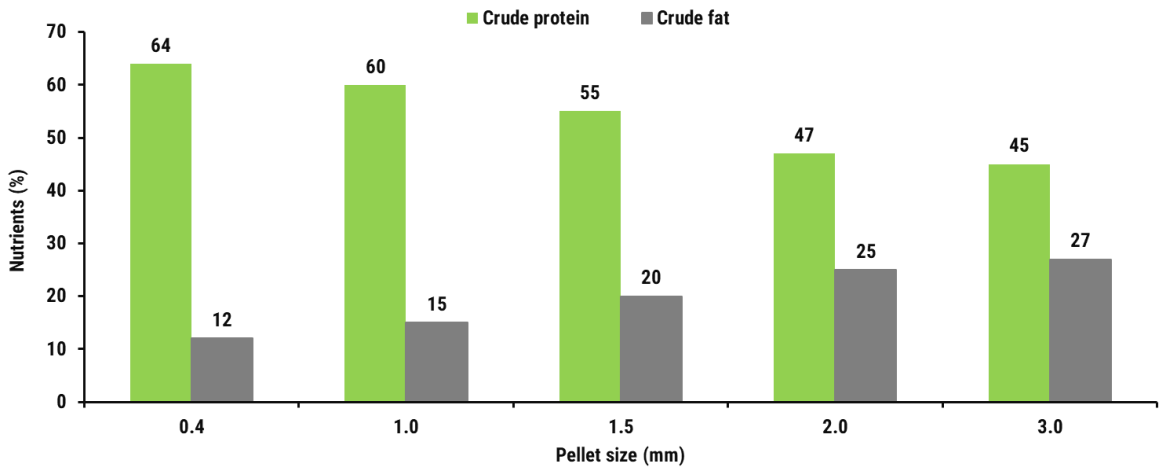

Figure 2: Exemplary nutritional values of salmonid feeds in different pellet sizes

Fry feeds contain a high amount of easily digestible protein to ensure healthy development in juvenile rainbow trout. Fat, as the primary energy source, plays a secondary role at this early stage. Instead, oils are added to the feed mixture, which are physiologically important and mostly derived from marine sources. The long-chain omega-3 fatty acids (e.g., EPA and DHA) contained in these oils are vital building blocks for life and essential for a species-appropriate diet. As development progresses, the ratio gradually shifts, as the relative protein requirement decreases. Excess protein is not used for muscle development but as an inefficient energy source. To counteract this, feed manufacturers add higher amounts of oil while simultaneously reducing the protein content. This leads to the “protein-sparing-effect”, which improves feed efficiency and reduces the reliance on expensive proteins. Additionally, the nitrogen input into the water environment is reduced. Thereby, the different sizes of fry feed help improve both the ecological and economic balance of fish farming operations.

Furthermore, the adjusted pellet sizes promote an even feed intake among the young fish. A homogenous distribution of feed is important, especially with a restrictive feeding strategy where fish receive a daily ration based on their body weight (as opposed to feeding until apparent satiation). A premature switch to larger feed pellets can lead to some juveniles falling behind. The consequences are a heterogeneous stock and poorer feed efficiency. In the worst case, weaker fish only consume pellets sporadically and suffer from malnutrition, while some of the larger fish already struggle with the early signs of obesity. While this imbalance can be mitigated through regular sorting, this means increased labour for the staff and additional stress for the fish, which can lead to higher mortalities.

Are special fry feeds a requirement?

In recent years, many agricultural products, such as oilseeds or plant proteins, have been significantly affected by price increases. However, protein-rich marine raw materials, such as fishmeal, remain at the top of price rankings. While the reduction of marine raw materials in grower feeds has been the primary focus of research for decades, the same does not apply to fry feeds due to the specific nutrient requirements of juvenile fish. Consequently, fry feeds are significantly more expensive compared to grower feeds. Some may wonder: "Isn't it possible to ground down larger pellets and feed the fragments to juveniles to save costs?" But beware! This is faulty logic. For one, the potential cost savings are minimal: Figure 3 shows the share of fry feed in the total feed requirement for two production methods, where the rainbow trout reach their market weight at either 600g or 2000g. The proportion of fry feed in the production of "seatrouts" is only about 0.5% of the total feed requirement.

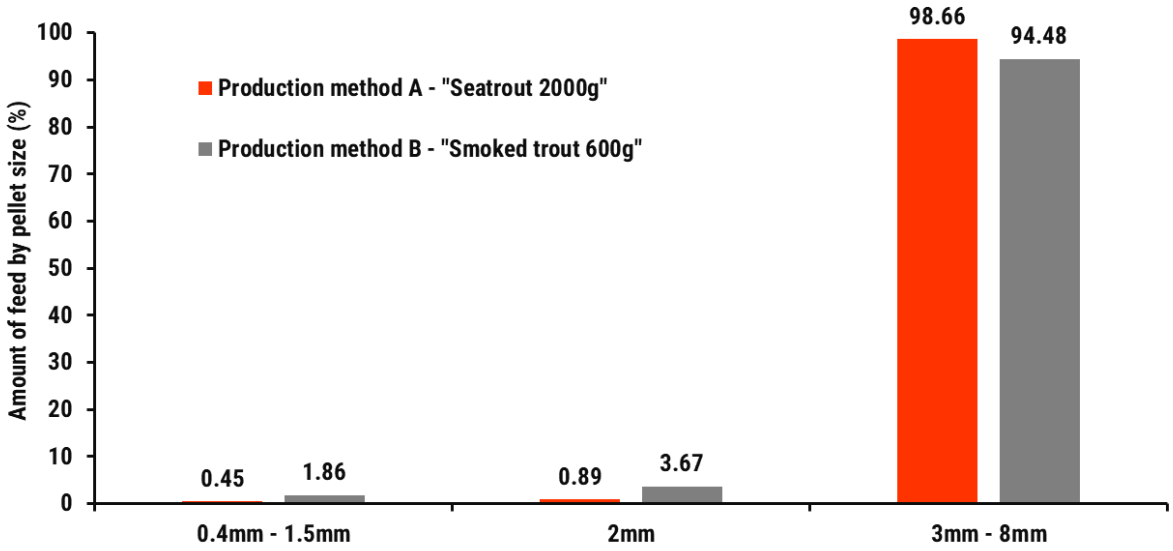

Figure 3: Feeds of different pellet sizes and their respective share of total feed requirements (%)

Moreover, the nutrient requirements of the juveniles remain the same, regardless of the feed they receive. In practice, this means either compensatory feed intake (the fish eat more to meet their needs for nutrients such as amino acids or minerals necessary for bone formation, while other nutrients are already in excess, are poorly digested, and thus increase water pollution) or the fish suffer from malnutrition. In both cases, the feed efficiency decreases, and the performance data of restrictively fed, freshly hatched trout, as shown in Figure 4, cannot be achieved.

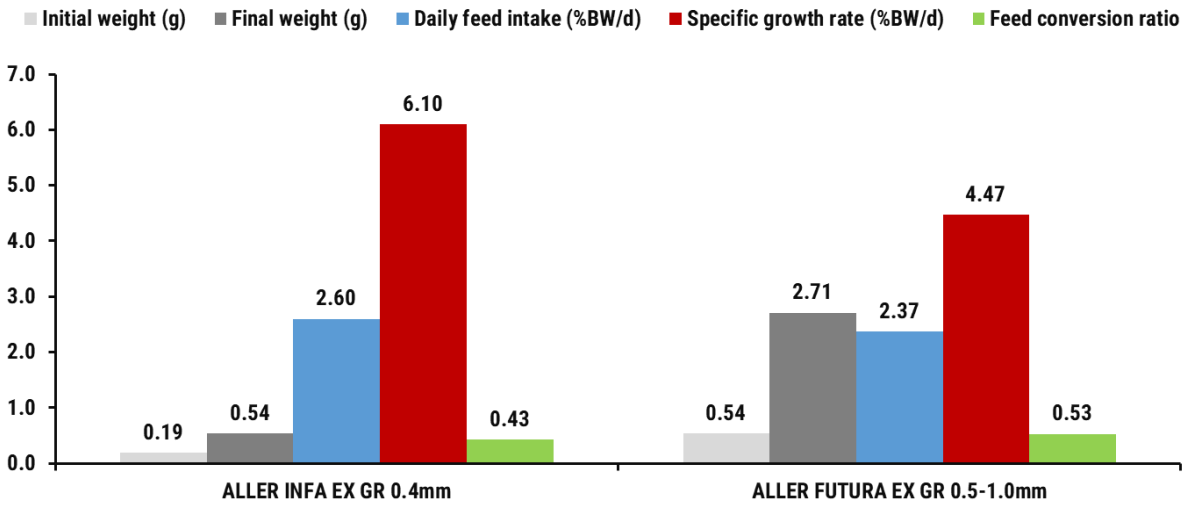

Figure 4: Performance data of restrictively fed rainbow trout

Finding an optimal feeding strategy

The following applies not only to fry feeds but in general: Fish require a certain amount of nutrients to meet their basic metabolic needs. They need to swim, breathe, digest, supply energy to their organs, and so on. The lower the feed intake, the greater the proportion of the ration required for these basic needs. Consequently, fewer nutrients are available for the fish to convert into growth – feed efficiency decreases as the ration approaches basic needs. On the other hand, high feeding rates influence the feed conversion: the higher the feed supply, the less efficiently it is used. There is thus an optimal level of feed efficiency between maintenance feeding and feeding to satiation. This optimum varies depending on temperature and the size of the fish. To provide fish farmers with a solid guideline and help them develop a feeding strategy, reputable feed manufacturers usually provide a recommendation, often available on the product's datasheet. Aller Aqua's feeding recommendations always focus on optimal feed efficiency, meaning that actual feeding should at least meet these recommendations.

Name and type

Fry Feed

Nutritional values and compositon

DECLARATION

	0.5-1.0 mm	0.9-1.6 mm	1.3-2.0 mm
Crude protein (%)	60	60	58
Crude fat (%)	15	15	17
NFE (%)	5,7	5,7	6,1
Ash (%)	12,6	12,6	12,2
Fibre (%)	0,7	0,7	0,7
P (%)	1,4	1,4	1,4
Gross energy (MJ)	21,2	21,2	21,6
Digestible energy (MJ)	19,7	19,7	20,0

COMPOSITION

Raw materials listed alphabetically. The full composition will appear on the label

fish meal, fish oil, functional ingredients, grain products, krill meal, single cell proteins, vegetable proteins, vitamins and minerals.

Feeding recommendation

RECOMMENDED FEEDING LEVELS

Kg feed per 100 kg fish per day

		Water temperature (°C)									
Fish (g)	Granulate		2	4	6	8	10	12	14	16	18
0.5-2.0	0.5-1.0	0.5-1.0	0,99	1,32	1,64	1,97	2,47	2,96	3,16	3,29	3,09
2.0-7.0	0.9-1.6	0.9-1.6	0,84	1,12	1,4	1,68	2,1	2,52	2,68	2,8	2,63
7.0-15.0	1.3-2.0	1.3-2.0	0,7	0,94	1,17	1,41	1,76	2,11	2,25	2,34	2,2

Environmental impact

ENVIRONMENTAL IMPACT WITH EXEMPLARY FEED CONVERSION RATIOS

Figures are per 100 kg fish production

	0.5-1.0 mm			0.9-1.6 mm			1.3-2.0 mm		
Feed conversion	0,5	0,6	0,7	0,6	0,7	0,8	0,7	0,8	0,9
N in faeces (kg)	0,29	0,35	0,4	0,35	0,4	0,46	0,39	0,45	0,5
N in water (kg)	1,76	2,66	3,57	2,66	3,57	4,47	3,36	4,23	5,1
P in faeces (kg)	0,21	0,25	0,29	0,25	0,29	0,34	0,29	0,34	0,38
P in water (kg)	0,06	0,16	0,26	0,16	0,26	0,35	0,26	0,35	0,45

ENVIRONMENTAL IMPACT MEASURED IN CO_2-EQ

Figures are in CO_2-equivalents (kg/kg feed)

	0.5-1.0 mm	0.9-1.6 mm	1.3-2.0 mm
CO_2-eq. with land use change	1,11-1,28	1,11-1,28	1,11-1,28
CO_2-eq. without land use change	1,08-1,23	1,08-1,23	1,08-1,23

Figure 5: Exemplary datasheet of ALLER FUTURA EX GR

From an economic perspective, it can make sense to exceed feeding recommendations. While higher feeding negatively impacts efficiency, it positively affects growth performance, meaning the fish reach their market size faster. There can be many good reasons for this, such as increasing annual production volume, compensating for seasonal influences, or meeting customer demands on time. Successful fish farmer often perform better because their experience helps them optimize and implement the feeding strategy. Figure 6 shows how much time or feed can be saved depending on the strategy used. From first feeding until an individual weight of 30g, restrictively fed trout require 1.1g less feed per fish (approximately 5%). However, the rainbow trout take about a month longer to reach the same weight.

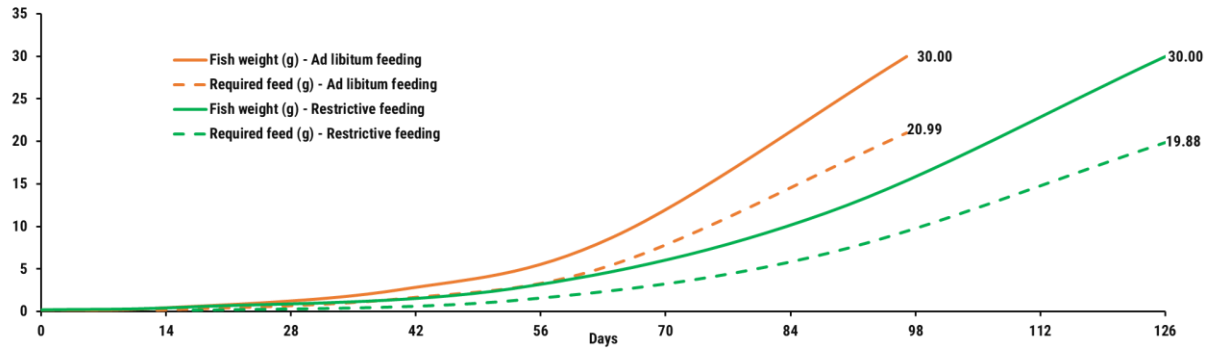

Figure 6: Comparison of juvenile rainbow trout fed either restrictively or until apparent satiation

Regardless of which strategy is chosen, it is crucial that feedings are carried out correctly. When feeding a restrictive amount, it is important to distribute the pellets as evenly as possible so that all fish receive their fair share. When feeding to satiation, special care must be taken to ensure that no pellets sink to the bottom, as salmonids generally do not pick up feed from the ground. Sunk feed will mold after a few days, releasing nutrients into the water, leading to eutrophication and increasing the microbial load. Incorrect feeding not only leads to economic losses but also endangers the rearing environment and the ecological integrity of the water. When using automated feeders, it is important to regularly check that the above criteria are fully met.

Conclusion

Breeding stocks and hatcheries ensure independent operations and can significantly reduce the risk of introduced infectious diseases. Those with the right conditions, who invest time and effort, and fully exploit the potential of fry feeds, can ensure species-appropriate, resource-efficient, and economically successful rearing.