EGTOP/2019

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT

Directorate B. Quality, Research & Innovation, Outreach
B.4. Organics

Expert Group for Technical Advice on Organic Production

EGTOP

Aquaculture Part D Final report

The EGTOP adopted this technical report at the plenary meeting of 3 to 5 December 2019.

About the setting up of an independent expert panel for technical advice

With the Communication from the Commission to the Council and to the European Parliament on a European action plan for organic food and farming adopted in June 2004, the Commission intended to assess the situation and to lay down the basis for policy development, thereby providing an overall strategic vision for the contribution of organic farming to the common agricultural policy. In particular, the European action plan for organic food and farming recommends, in action 11, establishing an independent expert panel for technical advice. The Commission may need technical advice to decide on the authorisation of the use of products, substances and techniques in organic farming and processing, to develop or improve organic production rules and, more in general, for any other matter relating to the area of organic production. By Commission Decision 2017/C 287/03 of 30 August 2017, the Commission set up the Expert Group for Technical Advice on Organic Production.

EGTOP

The Group shall provide technical advice on any matter relating to the area of organic production and in particular it must assist the Commission in evaluating products, substances and techniques which can be used in organic production, improving existing rules and developing new production rules and in bringing about an exchange of experience and good practices in the field of organic production.

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ACKNOWLEDGMENTS

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All declarations of interest of Sub-Group members are available at the following webpage: www.organic-farming.europa.eu

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The group made the following conclusions:

Review of current stocking densities. The group do not consider stocking density in itself as an appropriate fish welfare indicator. Nevertheless, the group recognizes the need to establish a holistic approach to evaluating fish welfare, which could be easily understood by consumers, communicated and monitored. To this purpose, threshold values of stocking density can be adopted together with a routinely assessment of fish conditions, overall health and water quality. The levels of dissolved oxygen (DO), below which farmers should proceed to reduce stocking density or put in practice other safe operations are the following: marine fish 80% saturation; salmonids 70% saturation; carp 50% saturation.

Stocking density of American brook trout *(Salvelinus fontinalis)*, Grayling *(Thymallus thymallus)*, American lake trout (or grey trout) *(Salvelinus namaycush)* and Huchen *(Hucho hucho)*. The group is inclined to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008.

Stocking density of Rainbow trout (*Onchorhynchus mykiss*). The group opinion is to maintain the current stocking density limits reported in the Regulation (EC) No 889/2008.

Stocking density of Arctic charr (*Salvelinus alpinus*). The group opinion is to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008.

Stocking density of Salmon (*Salmo salar*) in freshwater environment. The group opinion is to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008.

Stocking densities of Salmon, Brown trout and Rainbow trout in sea water. The group opinion is to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008.

Stocking densities of several species on the basis of “size” approach. Such approach does not seem effective for the declared purpose.

Stocking density of Burbot (*Lota lota*). The group recommends awaiting future progress in burbot aquaculture before defining production rules other than those already defined in the Regulation (EC) No. 889/2008, Annex XIIIa.

Stocking density of European perch (*Perca fluviatilis*). The group consider the monoculture of European perch, with stocking densities not higher than 20kg/m^3, in line with the Regulation EC No. 889/2008.

Permitted feed sources and feed additives. The group recommends including in the organic regulation, the following list of new ingredients:

a) Essential amino acids and lipids obtained by fermentation of natural substances of microbial (non-GMO) origin, for carnivorous fish feed only.

b) Single cell proteins (SCP), i.e. protein produced in bacteria cells and soluble fish protein concentrate of organic origin, with the prescription that genetically engineered microbes to produce SCP is not allowed.

c) New organic alternative protein ingredients species-specific (PAPs produced from organic agriculture, organic insects’ meal, etc.).

Maximum percentage for fishmeal and fish oil for carnivorous aquaculture animals. The group opinion is that the limitation of 30% of fish meal (FM) and fish oil (FO) derived from “whole fish” may be applied only in case other new ingredients are authorized and available.

Such limitation should not include FM and FO derived from trimmings. Without prejudice to all other restrictions provided by the Regulation (EC) No. 889/2008.

Flexibility within the overall limits of 35% for fishmeal and fish oil for penaeid shrimps and prawns. The group opinion is that there is no reason to increase the levels of fish meal inclusion to 35% for a supplementary feed.

Maximum percentage for fishmeal and fish oil for tilapia (*Oreochromis spp*). The opinion of the group is that in the case of freshwater fish, such as tilapia and pangasius, being all them omnivorous/herbivores, the use of supplementary feed with fish meal and fish oil included is not recommended. However, since Pangasius currently has a limited percentage of FM/FO allowed, from Regulation (EC) No 889/2008, this authorization could be phased out in an adequate period.

Feeding requirements for carp family. The opinion of the group is that, in the case of freshwater fish, such as carp, tilapia and pangasius, being all them omnivorous/herbivores, the use of supplementary feed with fish meal and fish oil included is not recommended.

Fish in inland waters. The group does not understand the meaning of the question and, in order to avoid possible misunderstanding, kindly ask the MS to better clarify the subject of the question.

Organic insects for aquaculture animals. In the group’s opinion, although very promising, the use of insect meal is not yet fully operational. Furthermore, the group does not recommend allowing a temporary use of non-organic insect’s meal, while the results of the expert group on the organic production of insect are expected.

Measures to limit the use of allopathic treatments for invertebrates. In the group’s opinion, the absence of any kind of residues (not only allopathic medicines) is clearly handled in the new organic Regulation (EU) 2018/848. Other possible legal implications of the proposal are not in the competence of EGTOP.

Review of number and frequency of parasites treatments for juveniles of rainbow trout. The group recommends allowing parasite treatments for salmon once a year when the production cycle is < 18 months and twice a year when the production cycle is > 18 months, only in the case that the salmon farm already uses cleaner fishes in the cages, and provided that cleaner fish shall be from sustainably managed fisheries or from aquaculture operations. Whatever the length of the production cycle, no more than 4 treatments can ever be administered.
The group recommends allowing parasite treatments for trout once a year when the production cycle is < 12 months and twice a year when the production cycle is > 12 months, but never more than 4 treatments in total.
For other organically farmed species the provisions adopted for the trout will be applied, until further scientific and/or empirical evidence intervenes.
The group recommends banning parasite treatments with chemically synthesized allopathic medicinal products in the grow-out stages of aquaculture animals, as referred to in Annex XIIIa, Section 6, Section 7 and Section 9 of the Regulation (EC) No. 889/2008. However, if chemically synthesized allopathic medicinal products are applied as parasite treatment, then it falls under the limitation of the maximum number of allowed allopathic treatments (compulsory national schemes for parasite treatments are not counted).
Above all, the group would welcome a survey among MSs to ascertain the use of allopathic / parasitic treatments (frequency and type of parasite treatments) in organic aquaculture (possibly including other terrestrial animals as well).

Pending questions from EGTOP report 2018 on Fertilizers III.

For cultivation of macroalgae/microalgae/cyanobacteria, nutrients from terrestrial animal origin should be permitted, with the restriction reported in the Annex I of the Regulation (EC) No. 889/2008 and provided that any microbial contamination of the final product can be avoided.

All efficient and environmentally friendly technologies for nutrient recycling are welcomed, therefore the group is not against permitting the N-Stripping technology, if animal nutrients from factory farming are excluded. The integrity of organic food/feed will not be undermined by allowing N-recovery from animal manure, biogas digestates as listed in Annex I of the Regulation (EC) No. 889/2008. Food/feed safety concerns can be addressed by a functioning quality control system with regular microbiological testing of the source of animal nutrients.

Ammonium sulfate originating from N-Stripping has a high solubility which is not in line with the organic principles for crop production (as highlighted in EGTOP report Fertilisers III). In order to avoid any misunderstanding, the use shall be restricted to macro-/microalgae production in closed and land-based systems.

1. TERMS OF REFERENCE

In the light of the most recent technical and scientific information available to the experts, the group is asked to address the list of items in Annex 1 and assess whether and which new measure in line with the rules laid down in Regulation (EC) No. 834/2007, in Regulation (EC) No. 889/2008 and in Regulation (EU) No. 2018/848 could be proposed for organic aquaculture.

Most of the items included in this mandate have been identified during the discussions held with Member States (MS) on the proposals for secondary implementing legislation under Regulation (EU) No. 2018/848. All references of scientific articles quoted by Member States when proposing new measures, as well as any document submitted to the Commission in this context, are listed in the Annex 2.

For the preparation of its report, the group is invited to assess the proposals listed in Annex 1, taking into account the conclusions of EGTOP reports on Aquaculture (parts A, B and C) and on Fertilizers III (point 3.5.), together with more recent scientific and technical knowledge to assess whether and which proposals are in line with the objectives, criteria and principles as well as general rules laid down in organic legislation. The group should also examine the technical documentation provided to the Commission by the Member States (listed in Annex 2). Finally, the group is invited to advice and suggest, when relevant, new measures.

2. CONSIDERATIONS AND CONCLUSIONS

2.1. Review of current stocking densities

2.1.1. General considerations

Most of the considerations hereinafter reported are taken by the previous reports delivered by EGTOP (i.e. Aquaculture Part A, adopted on December 2013; Aquaculture Part B, adopted on July 2014; Aquaculture Part C, adopted on September 2016), as well as by the Deliverable D6.1 and D6.2 of the FP7 EU Project OrAqua. Indeed, in the group's opinion, the arguments reported in those documents are still valid and contribute effectively to outline the picture of the complex interactions between stocking density, water quality and fish welfare.

Stocking density encompasses a complex web of interacting factors, such as water quality, social interactions, fish to fish interaction and fish to housing interaction that can have an effect on many aspects of welfare (Ashley, 2007; Turnbull et al., 2008). Water quality is a crucial factor that could affect fish health and survival. Lack of oxygen (hypoxia) may be the major challenge in organic production, since the addition of oxygen is restricted through the regulation (Regulation (EC) No 889/2008, Art. 25h (4). The waste derived from uneaten fish feed and its metabolic end products, faeces and dissolved inorganic nutrients could seriously impair water quality. Dissolved oxygen (DO) levels in water is a pivotal factor that contributes to modulate fish sensitivity to other water quality parameters. Polluted water are characterized by low levels of DO and many of the physiological responses of fish to chemical pollutants, at acute concentrations, are similar to those produced in response to environmental hypoxia. Furthermore, hypoxia is not limited to freshwater habitats, but arises across different production systems. Indeed, oxygen levels in the oceans vary with the depth, temperature, salinity and productivity.

Other factors to pay attention, when considering the effects of stocking density upon welfare, is the increase of the energetic expenditure for basal life functions, that in turn could become detrimental for growth, immune-resistance, and could also affect the social interaction between fish (Huntingford, 2004; Martins et al., 2012). From a physiological point of view, high stocking density increases red muscle activity leading to a rise of the global scope for activity (Lembo et al., 2007; 2019). Also Stress coping styles (SCS), which is defined as a coherent set of individual physiological and behavioural differences in stress responses, appear promising for establishing a better understanding of the physiological and behavioural responses of fish to stress factors in the aquaculture context (Carbonara et al., 2019). Generally, environmental enrichment has been shown to have positive effects on animal welfare. Although, still information on individual differences in responses to this is lacking. Proactive and reactive individuals differ in behavioural flexibility, implying that environmental variability/enrichment may affect fish with contrasting SCS (Coppens et al., 2010).

However, the overall picture arising from the studies performed to date investigating the effects of stocking density on different welfare parameters suggests that both low and high densities are potentially detrimental to fish welfare. High stocking density potentially increases the risk of prevalence of diseases, but incidence of disease may as well be related to water quality, environmental and management conditions. Indeed, the effect of density levels on welfare may vary greatly between studies, due to the case study-specific nature of experiments. For example, studies vary in experimental duration, water quality, density levels used, feeding methods, size of the fish, life history of the fish, level of domestication, type of rearing system used and environmental conditions. A density threshold for one set of conditions may, therefore, not be relevant for another (Ashley, 2007) and makes comparison of the results between studies difficult. Interestingly, what is considered low density and what is considered high density appears to be quite ambiguous, as these ‘definitions’ vary between studies. Furthermore, the results of these studies clearly illustrate the complex nature of the relations between stocking density and fish welfare, with several environmental factors interacting together and with density, as well as influencing the indicators of welfare and performance.

Nevertheless, it is worth to highlight that all the experiments on the stocking density reported in the literature provided by MSs are based on the routinely use of oxygen to adapt the water quality to the increased stocking density, which is clearly not in line with the current organic regulation. Therefore, those figures on stocking densities, reported by the cited scientific literature, do not help to define appropriate standards for organic aquaculture.

2.1.2. Reflections of the group

In the light of the above arguments, and according to previous advices expressed by EGTOP, the group do not consider stocking density in itself as an appropriate fish welfare indicator, unless it is considered in a holistic approach and linked to environmental conditions, water quality, feeding quality, life history of the fish, level of domestication, type of rearing system used, etc.

However, the group recognizes the need to establish a holistic approach to evaluating fish welfare, which could be easily understood by consumers, communicated and monitored according to the Regulation (EC) No 889/2008, Art. 25f (2). To this purpose and to preserve optimal fish welfare conditions, threshold values of stocking density, per species or group of species, can be adopted in the organic regulation, but together with a routinely assessment of fish conditions, such as fin damages, other injuries, growth rates, behaviour expressed, overall health and water quality. Above all, the level of oxygen concentration is relevant for assuring good welfare conditions.

The figures in Annex XIIIa of the Regulation (EC) No 889/2008 are threshold values which, on average, represent safer fish welfare conditions. These limits are based on farmers knowledge, as well as on scientific evidence and aim at differentiating between organic and conventional aquaculture. In addition, they account for the ban on the routinely use of oxygen, established by the organic regulation. Overall, these limits have been successfully applied over the last few years in EU organic aquaculture. Even if slightly higher stocking densities might be possible under specific, local conditions, this does not mean that this would be possible for the whole sector.

In the group’s opinion, the routinely monitoring of the oxygen concentration of the rearing waters is a highly suggested best practice. The levels of DO, below which farmers should proceed to reduce stocking density or put in practice other safe operations are the following: marine fish 80% saturation; salmonids 70% saturation; carp 50% saturation.

In the following paragraphs, the positions of the group with respect to the specific questions contained in the mandate are reported, point by point.

2.2. Proposal to increase stocking densities for the group “freshwater salmonids”

2.2.1. Reflections of the group and conclusion

a) The group does not have information about current commercial operations in Europe for American brook trout *(Salvelinus fontinalis)*, Grayling *(Thymallus thymallus)*, American lake trout (or grey trout) *(Salvelinus namaycush)* and Huchen *(Hucho hucho)*. In addition, the group is not aware of scientific evidences that safer stocking density for the above species can be raised to 25 kg/m^3. Therefore, the group is inclined to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008, until further scientific or empiric information is provided on the appropriate management practices required by these species.

b) As far as the maximum stocking density for rainbow trout (*Onchorhynchus mykiss*), the group takes note that MSs expressed conflicting opinions on the subject. In addition to this, at the light of the considerations expressed in the paragraph 2.1.2. and taking into account the ban on the routinely use of oxygen established by the organic regulation, the group opinion is to maintain the current stocking density limits reported in the Regulation (EC) No 889/2008.

c) As far as the maximum stocking density for Arctic charr (*Salvelinus alpinus*), the group takes note that MSs expressed contrasting opinions on the maximum level that can be allowed. In addition to this, at the light of the considerations expressed in the paragraph 2.1.2. and taking into account the ban on the routinely use of oxygen established by the organic regulation, the group opinion is to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008.

d) As far as the maximum stocking density for Salmon (*Salmo salar*) in freshwater environment, the group takes note that MSs expressed conflicting opinions on the subject. In addition to this, at the light of the considerations expressed in the paragraph 2.1.2. and taking into account the ban on the routinely use of oxygen established by the organic regulation, the group opinion is to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008.

2.3. Proposal to increase stocking densities for Salmon, Brown trout and Rainbow trout in sea water

2.3.1. Reflections of the group and conclusion

a) As far as the maximum stocking density for Salmon (*Salmo salar*), Brown trout (*Salmo trutta*) and Rainbow trout (*Oncorhynchus mykiss*) in marine water, at the light of the considerations expressed in the paragraph 2.1.2. and, particularly, in order to avoid the onset and spread of diseases, the group opinion is to maintain the current stocking density limit reported in the Regulation (EC) No 889/2008.

2.4. Proposal to increase stocking densities for several species on the basis of "size" approach

2.4.1. Reflections of the group and conclusion

a) As far as the proposal to define stocking density limits based on the size of the fish and, in particular, 20 kg/m^3 under 2 kg and 10 kg/m^3 above 2 kg for the species in Annex XIIIa, Section 1, Section 3, Section 5 and Section 9 of the Regulation (EC) No 889/2008, the group highlights that most of the species considered (apart from salmon) are not marketed over 2 kg, therefore such approach does not seem effective for the declared purpose.

2.5. Stocking density, production and containment systems for new species

2.5.1. General considerations about stocking density for burbot (*Lota lota*)

The proposal to include burbot in Annex XIIIa with a stocking density limit of 25 kg/m³ was delivered to EGTOP without any supporting scientific or empirical documentation. Indeed, the group is not aware of any commercial aquaculture farming of burbot, currently operating in EU member states, nor in third countries. On the way to diversify European aquaculture burbot is seen as a promising candidate due to some fish specific properties (e.g. fast growth rates, low temperature fish, white and tasty fillets, delicacy in some EU countries). Research and development of burbot aquaculture have received significant public funding in the last years from both national and EU programmes (for example AquaVLAN co-funded by the European Interreg Programme[1]). In the mentioned context, several research projects investigated burbot hatching, nurseries, weaning and grow out production, resulting in a better understanding of species-specific growth parameters under aquaculture conditions. However, most of the research done is linked to burbot aquaculture in Recirculation Aquaculture Systems (RAS), with high stocking densities and related high oxygen supply (Tschudi et al., 2017).

2.5.2. Reflections of the group and conclusion for burbot (*Lota lota*)

Given that no commercial aquaculture farming of burbot are known, the group cannot refer to practical experiences of fish farmers, nor to sound burbot aquaculture farming in containment systems eligible for organic aquaculture. Moreover, what is more important, is that burbot aquaculture is still in an experimental stage and linked to RAS, which are not allowed in organic aquaculture.

Therefore, due to a lack of scientific and empirical data on burbot aquaculture in open systems, the group is presently not in the position to define a sound stocking density for burbot farming. The group recommends awaiting future progress in burbot aquaculture before defining production rules other than those already defined in the Annex XIIIa.

2.5.3. General considerations about stocking density for European perch (*Perca fluviatilis*)

European perch is a minor species “by-catch” in traditional European polyculture systems dominated by carps (*Cyprinus carpio*). European perch from polyculture systems can be already certified organic (see Annex XIIIa Section 6). Unlike for burbot**,** perch domestication and perch monoculture has been advanced in the last 25 years and reached commercial scale (Fontaine and Teletchea, 2019). A driver of this development is the European Percid Fish Culture Group under the umbrella of the European Aquaculture Society (https://www.epfc.net).

Today, a strong focus is given on perch culture in RAS systems with stocking densities up to 80 kg/m³. European perch sold in European markets (mainly in Switzerland and other alpine regions) originates either from wild catch or from RAS perch culture. Almost all producers of conventional perch approach the Swiss market where perch is well received by consumers and therefore listed by all retailers. As far as the group is aware only in Ireland a pond-based perch aquaculture has been developed on a trial basis with strong involvement of various Irish stakeholders, like Ireland’s Seafood Development Agency (BIM)[2].

After some years of research an outdoor “Recirculating Aquaculture Multi-Trophic Pond Systems (RAMPS)” shows the best results so far combining advantages of low-cost pond culture with positive effects of a recirculating system. The RAMPS system is based on a split pond aquaculture system, which has been developed for catfish aquaculture in the United States.

[1] https://projects.odisee.be/Aqua-ERF/sites/default/files/posterCluj.pdf
[2] http://www.bim.ie/our-work/projects/ramps/

The system basically separates fish production and oxygen production/waste removal into two (or more) ponds where the water is recirculated using paddle wheels for water transport. Sensors are constantly measuring dissolved oxygen (DO) in all the ponds. If algae are not producing enough dissolved oxygen (which happens in the night) oxygen is pumped into the system, allowing to work with nearly zero-water exchange (except after heavy rainfall or high evaporation rates). Excess nutrients (from feed waste, faeces etc.) are taken up by water plants (e.g. duck weed) and can be recycled into agricultural material cycles. According to information given by BIM, trial production uses stocking densities of about 20kg/m³. The stocking density of 20 kg/m³ has also been chosen by the Swiss organic association BioSuisse for European perch aquaculture in ponds and net cages[3].

2.5.4. Reflections of the group and conclusion for European perch (*Perca fluviatilis*)

In the group's opinion, there is no scientific reason to exclude perch aquaculture from monoculture systems. Indeed, when the first organic aquaculture production rules had been developed perch was mainly farmed in the traditional polyculture system.

The outdoor "Recirculating Aquaculture Multi-Trophic Pond Systems (RAMPS)" seems a promising system combining the advantages of low-cost pond culture with the positive effects of a recirculating system (high water efficiency). However, further technical progress is needed to avoid the routinely use of oxygen to compensate the lack of dissolved oxygen, which is not produced by algae during the night.

Taking into account the information produced by BIM and the experiences gained by the organic association Bio Suisse in the perch aquaculture, the group consider the monoculture of European perch, with stocking densities not higher than 20kg/m³, in line with the Regulation (EC) No. 889/2008. Following a precautionary approach, the group consider advisable a revision of such stocking density threshold in the light of the forthcoming operational experiences.

2.6. Permitted feed sources and feed additives

2.6.1. General considerations

Fish species-specific physiological limitations and metabolic effects of both single chemicals and complex chemical matrixes are factors to be considered in producing fish aqua feeds, robust fish and a healthy aquaculture sector. In addition, optimization of feed management practices is needed. Fish need nutrients, as opposed to ingredients, and especially essential nutrients, such as protein, minerals and fats that form the basic components of a balanced diet and the key criterion is the quality of such nutrients.

Fish meal (FM) has an essential amino acid (EAA) and fatty acid (FA) profile that is adequate for most fish species, whereas the EAA profile of alternative ingredients is usually unbalanced (Gómez-Requeni et al. 2004; Hernández et al., 2014; González-Rodriguez et al., 2016) and could supress fish growth when fish meal (FM) is replaced at high levels (Yigit et al., 2006; González-Rodriguez et al., 2016). Thus, replacement of FM protein by alternative protein sources or setting a maximum percentage of FM and fish oil (FO) for carnivorous organic aquaculture requires a careful adjustment of the dietary EAA profile to that of animal's requirements. Therefore, supplementation of diets with limiting EAAs is generally required (Zhou et al. 2011; Karapanagiotidis et al. 2019)

[3] https://www.bio-suisse.ch/media/en/pdf2003/requirements_production_of_edible_fish.pdf

The demand to identify alternative sources of dietary protein and lipids for organic feeds in organic aquaculture and to reduce the use of FM and FO in organic feeds is an ongoing effort due to the worldwide overfishing situation. Research continues to evaluate novel formulated alternative ingredients and assess product quality to meet the challenges for the production of the organic feeds. In addition, sensitivity to alternative ingredients is species specific and fish's developmental stage related. Further extensive studies are still required to have a clearer picture of the potential negative effects of alternative ingredients in gut microbiota, immune parameters and overall fish health status.

A mixture of the feed ingredients that offer the best percentage for each nutrient, according to the fish requirements and the specific nutrient demand of each fish species, is what the research aim for when diets are formulated (Mente et al. 2019). Using mixtures of alternative raw materials that may complement one another, in terms of amino acid and fatty acid composition, is a more adequate strategy for replacing FM/FO ratio in fish diets. In addition, the total nutritional value of the feed depends not only on the total nutrient content of the specific nutrients, but also on its digestibility and utilization by the animal to convert those nutrients into growth. Several studies have been dedicated to enable the use of a broad suite of feed ingredients when diets are formulated and to evaluate them against the specific nutrient requirements of each of the fish species (Hardy, 2010; Kousoulaki et al. 2016; Glencross et al. 2019). However, for juvenile fish stage such alternative diets are not recommended as growth depression is severe.

Single-cell proteins (SCP) refers to a refine or edible protein extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria. These microorganisms have a very high content of protein and can be grown using inexpensive substrates such as wood, straw, cannery, and food-processing wastes, residues from alcohol production, hydrocarbons, or human and animal excreta. SCPs are found in very low concentration (less than 5%) and need to be concentrated either by centrifugation, flotation, precipitation, coagulation and/or filtration that increase production costs. They also need to be dehydrated and/or acidified before being stored to prevent spoilage. Large-scale SCP production has multiple advantages over conventional food production practices: high rate of multiplication and large quantity of biomass produced in a short time, broad variety of materials used as substrate, production independent of climatic conditions. Few drawbacks also exist, i.e. the high level of nucleic acids in the biomass that may lead to gastrointestinal problems, the cost of production.

2.6.2. Reflections of the group and conclusion

In the group's opinion, the current organic aquaculture regulation, i.e. Regulation (EC) No 889/2008, meets the animals' daily nutrient requirements for optimum growth performance and health, as well as ensures a high final edible product quality, with a low environmental impact. Indeed, the group considers the advices in the EGTOP Aquaculture report (Part A - 2013) and the Final Recommendations of the FP7 EU project OrAqua still valid.

As a further step forwards to a feed that takes into account the fish welfare and is environmentally friendly, the group recommends including in the organic regulation, the following list of new ingredients:

1. Essential amino acids and lipids obtained by fermentation of natural substances of microbial (non-GMO) origin, for carnivorous fish feed only.
2. Single cell proteins (SCP), i.e. protein produced in bacteria cells and soluble fish protein concentrate of organic origin, with the prescription that genetically engineered microbes to produce SCP is not allowed.

3. New organic alternative protein ingredients species-specific (PAPs produced from organic agriculture, organic insects' meal, etc.)

As far as the amino acids obtained by fermentation methods, the group considers it appropriate to point out that in the current Regulation (EC) No 889/2008 the use of histidine, obtained by fermentation, has been already allowed in order to meet the dietary needs of salmonids.

2.7. Set a maximum percentage for fishmeal and fish oil for carnivorous aquaculture animals

2.7.1. Reflections of the group and conclusion

As far as the maximum percentage of FM and FO for carnivorous species, the group takes note that MSs expressed conflicting opinions on the subject. Nevertheless, the group considers both the opinions that privilege the nutritional needs of fish, and those that privilege a more environmentally friendly approach (e.g. pointing out worldwide overfishing), worthy of attention.

Therefore, also in the light of the considerations expressed in the paragraphs 2.6.1. and 2.6.2., the group opinion is that the limitation of 30% of FM and FO derived from "whole fish" may be applied only in case other new ingredients, such as those listed in paragraph 2.6.2 are authorized and available. Such limitation should not include FM and FO derived from trimmings. Without prejudice to all other restrictions provided by the Regulation (EC) No 889/2008.

2.8. Flexibility within the overall limits of 35% for fishmeal and fish oil for penaeid shrimps and prawns

2.8.1. Reflections of the group and conclusion

The group considers the information provided in the EGTOP Aquaculture report (Part A - 2013), on nutritional requirements of penaeid shrimps and prawns, highly useful and still valid. A further confirmation of this may be found in the most recent scientific literature that reports values of protein requirements for shrimps around 20-45% (Velasco et al., 2000, Yun et al, 2015), depending on the shrimp size, water characteristics and feed formulation (Lee & Lee, 2018). The inclusion of FM in the diets is variable but nowadays is around 15-18% (Lee & Lee, 2018) and no clear effect of a higher inclusion of FM neither in survival or conversion rate has been observed.

It should also be noted that, according to the Regulation (EC) No 889/2008, penaeid shrimps and freshwater prawns shall be fed with feeds naturally available in ponds and lakes. Therefore, the feed ration of 25% FM and 10% FO is to be considered just as a supplement to the natural feed, when natural feed resources are not available in sufficient quantities.

Thus, the group opinion is that there is no reason to increase the levels of fish meal inclusion to 35% for a supplementary feed.

2.9. Set a maximum percentage for fishmeal and fish oil for tilapia (*Oreochromis spp*.)

2.9.1. General considerations

Tilapia (*Tilapia nilotica*) is a freshwater species (El Sayed, 2006) that is also fed using mostly plants and plant by-products. In some cases, formulated supplemental feeds are also provided to feed tilapia in semi-intensive systems, especially for juveniles and for short periods of time before being fed diets with higher plant protein ingredients during their longer grow-out stages (Ng & Romano, 2013). These feeds must be low in protein but high in energy content, since the fish get some of their protein requirement from natural food available in fish ponds. Protein requirements for tilapia are between 30-40% for juveniles (Abdelghany, 2000; Teshima and Kanazawa 1988) and 20-30% for adults (Al Hafed, 1999).

Pangasius is also a freshwater omnivorous fish that FAO describes as a nutritionally low input species. This means that it can be produced efficiently with low level of protein. It is usually farmed using feeds with 28 - 32% protein that primarily consist of grain-based materials or derivatives. It can also be farmed using homemade feeds or agricultural by-products, as well as additional nutrition from natural pond productivity (Pangasius can consume sediments and detritus to gain nutrition from bacteria and other organisms).

Both, tilapia and pangasius are freshwater white fish. Both fishes are characterized by similar traits and have their origins in tropical regions. They are easily adaptable to various production systems. Pangasius is an omnivorous fish, whereas tilapia has eating habits of a herbivore, and both are considered fast growing species. Taking into account these similar characteristics, the group does not see reasons to make differences between the feed rations of Pangasius and tilapia.

2.9.2. Reflections of the group and conclusion

The worldwide overfishing situation clearly require considering a progressive reduction in the use of FM and FO in fish feeds. In addition, the availability of FM/FO is currently limited and will be increasingly limited in the future (Gatlin et al. 2007; Amirkolaie 2011). Therefore, modern farming systems for herbivorous, omnivorous and carnivorous fish are all expected to rely more on diets containing a high percentage of plant ingredients (Naylor et al. 2000; Hardy 2008; Hua and Bureau 2012) or new ingredient such as those listed in paragraph 2.6.2.

The opinion of the group is that in the case of freshwater fish, such as tilapia and pangasius, being all them omnivorous/herbivores, the use of supplementary feed with fish meal and fish oil included is not recommended. However, since Pangasius currently has a limited percentage of FM/FO allowed, from Regulation (EC) No. 889/2009, this authorization could be phased out in an adequate period.

2.10. Feeding requirements for carp family

2.10.1. Reflections of the group and conclusion

The common carp (*Cyprinus carpio*) is a freshwater, omnivorous species with similar characteristics to tilapia and pangasius. It lives in all types of slow flowing or still waters, it is tolerant to water quality and temperature and its ecological spectrum is broad. Carp in the natural environment mainly feed on zooplankton and zoobenthos, detritus and parts of aquatic plants. When it is farmed in semi-extensive conditions, in lakes and ponds, the feed ration of carp is supplemented with soaked grain or beans, sometime with energy-rich grains (barley, maize and wheat) and other vegetables such as peas.

The opinion of the group is that, in the case of freshwater fish, such as carp, tilapia and pangasius, being all them omnivorous/herbivores, the use of supplementary feed with fish meal and fish oil included is not recommended.

2.11. Fish in inland waters

A MS asked for a definition of ponds, lakes and an opinion about the rules for fish in inland water if they can also be applied to extensive farming, polyculture, large bodies of water or the rules will be limited to natural bodies of water.

Natural bodies of water include lakes, ponds, large bodies of water (in land) and the rules should be applied to all of them. However, the group does not understand the meaning of the question and, in order to avoid possible misunderstanding, kindly ask the MS to better clarify the subject of the question.

2.12. Organic insects for aquaculture animals

2.12.1. General considerations

Apart from being considered as pests, insects are a promising, efficient and sustainable protein source for human food and animal feed (Henry et al. 2015; Gasco et al. 2018).

Recently, the Regulation (EU) No 2017/893, a major milestone for insect protein exploitation, that permits, regulates and clarifies the use of insect-based protein in fish feed, came into force, beginning from the 1st July 2017. According to this EU legislation, seven insect species are permitted for the production of animal feed in aquaculture: black soldier fly (*Hermetia illucens*), 2) housefly (*Musca domestica*), 3) mealworm or yellow mealworm (*Tenebrio molitor*), 4) lesser mealworm or litter beetle (*Alphitobius diaperinus*), 5) house cricket (*Acheta domesticus*), 6) tropical house cricket or banded cricket (*Gryllodes sigillatus*), and 7) Jamaican field cricket (*Gryllus assimilis*). These species are regarded as non-pathogenic and do not pose a risk for human, animal or plant health (Rumbos et al., 2018). Furthermore, they do not transmit human, animal or plant pathogens, i.e. are not regarded as vectors, they are not protected species or invasive alien species. In fact, they are now classified as "farmed insects" and have a similar status to livestock, according to Regulation (EC) No 1069/2009 and Regulation (EU) No 2018/848. However, for animal feed production purposes, cultivation of these insects is only allowed on specific kinds of substrates.

Feeding experiments with *T. molitor*, have shown that insect meal obtained from this species can be included at various percentages without negative effects on growth performance in the diet of several fish species, such as *O. mykiss* (Belforti et al. 2015), *D. labrax* (Gasco et al. 2016), *S. aurata* (Piccolo et al. 2017), the African catfish, *Clarias gariepinus* (Ng et al. 2001) and the black bullhead, *Ameiurus melas* (Roncarati et al. 2015). Similarly, Karapanagiotidis et al. (2014) showed that up to 30% replacement of fishmeal by *H. illucens* pre-pupae meal could be achieved without significant negative effects on the growth and feed utilization of *S. aurata*. Recent findings indicate that the most desirable fish diet substitution differentially affects the gut microbiota in different hosts, implying that a species-specific tailor-made approach in diet manipulations should be considered in the future (Antonopoulou et al., 2019). Kroeckel et al. (2012) demonstrated that diets rich in *H. Illucens* pre-pupae meal had a negative effect on the growth performance of turbot (*Psetta maxima L.*) juveniles, due to their limited capacity in chitin digestion, and suggested the integration of chitin degrading enzymes or bacteria into fish diets.

Insects are also a good source of essential amino acids (Rumpold & Schluter, 2013), with some species being particularly rich in lysine, methionine and leucine, for which most plant protein feed sources are usually deficient (Sanchez-Muros et al., 2014). For example, the meals from larvae of *H. illuscens, M. domestica, T. molitor*, and locust-cricket species, as well as pupae of silkworm, *Bombyx mori L.* (Lepidoptera: *Bombycidae*) could all serve as rich sources of methionine (1.4–3.5% of crude protein) and lysine (4.7–7.0%) in aqua feeds, with their levels being comparable with fishmeal and oil plant meals.

However, the vast majority of insect species lacks or contains very poor levels of 22:6n-3 (docosahexaenoic acid, DHA), which is one of the major polyunsaturated fatty acids that is essentially required by fish, particularly marine species. Therefore, the inclusion of full-fat insect meals in fish diets do not satisfy the essential fatty acid requirements of fish, but also could result in a lower lipid nutritive value of farmed fish. On the other hand, insects could also serve as valuable sources of 18:2n-6 and 18:3n-3 in farmed fish diets, with some terrestrial insect species being also particular rich in 20:4n-6, while some aquatic species being also particular rich in 20:5n-3 (eicosapentaenoic acid, EPA) (Sánchez-Muros et al. 2014). As potential aqua feed ingredients, it might be more appropriate to use those insect meals that have a higher suitable lipid and fatty acid profile and, in this context, aquatic insects might play a more significant role in future. Henry et al. (2015) reported that mass rearing of aquatic insects is restricted to the larvae of mosquitoes, which are mainly used for biological controls, and only one bibliographical reference is available about their use in fish nutrition (Ostaszewska et al., 2011). It is worth noting, for example, the high level (34.4%) of 22:6n-3 that has been reported for the shredding caddisfly, *Clistoronia magnifica* (Hanson et al., 1985), or the high levels of 18:3n-3, 20:5n-3 and n-3:n-6 ratio found in the spiny crawler mayfly, *Drunella grandis* (Sánchez-Muros et al. 2014).

Insects are also a good source of minerals (e.g. potassium, iron, magnesium, zinc and selenium) and vitamins (e.g. riboflavin, pantothenic acid, biotin and folic acid) (Schabel 2010), with their profile being largely affected by insect diet composition (Henry et al. 2015).

2.12.2. Reflections of the group and conclusion

Overall, insects as a feed component for animals in aquaculture have great potential due to their high energy and protein content. This potential has been recognized by EU legislation and several insect species have been permitted to produce animal feed for aquaculture. However, apart from some encouraging results from high percentage fishmeal substitution with insect meal in trout feed[4], there is still need for further research to confirm how and to what extent insect meal inclusion may impacts species-specific fish diets. In addition, further research effort is needed to develop a tailor-made approach in diet manipulations. A better understanding on how the production of insect meal can be optimized at an industrial scale, in conjunction with safety concerns, it is also required.

In the group’s opinion, although very promising, the use of insect meal is not yet fully operational. Furthermore, the group does not recommend allowing a temporary use of non-organic insect’s meal, while the results of the expert group on the organic production of insect are expected.

2.13. Measures to limit the use of allopathic treatments for invertebrates

A MS proposed to add the following requirement under point 3.1.4.2. of the Regulation (EU) No 2018/848: “After use of allopathic medicines, the absence of residues in the end product must be proven by suitable analysis”.

In the group’s opinion, the absence of any kind of residues (not only allopathic medicines) is clearly handled in the Regulation (EU) No 2018/848. Other possible legal implications of the

[4] http://www.aquafeed.com/news/headline-news-article/8876/Le-Gouessant-Aquaculture-and-Innovafeed-succeed-in-100-fishmeal-substitution-with-insect-in-rainbow-trout-feed/

above proposal are not in the competence of EGTOP.

2.14. Review of number and frequency of parasites treatments for juveniles of rainbow trout

2.14.1. General considerations

In the current organic regulation, the number of allopathic treatments is limited to two courses of treatment per year in case the production cycle is longer than 12 months (only one treatment if the cycle is less than one year). While, the number of parasite treatments (not including compulsory control schemes operated by MSs) is restricted to one in case of a production cycle less than 18 months or twice in case the production cycle is longer than 18 months.

The threshold of 18 month for the antiparasitic treatments has been included into the regulation mainly for salmon, which is the most important fish in the European organic food market. Salmon, like an anadromous fish, is reared the first 10 to 16 month in freshwater, while in the remaining 12 to 24 months in seawater and, on average, has a production cycle of 24-36 month. Because the sea lice problem does not occur within the period in freshwater, the threshold of 18 month was considered appropriate.

However, also other salmonids, or other genera from different fish families, might be affected by parasites (endo and/or ectoparasites). For example, rainbow trout is often affected by the parasite Costia (*Ichthyobodo necator*). Above all, fry and juvenile rainbow trout show a high mortality rate. The development of the parasite Costia depends on various factors. Low animal welfare conditions (higher stocking densities) and low water quality (for example low content of dissolved oxygen) supports the outbreak of the parasite. Currently, a Danish research project intends to develop a more robust production protocol for organic trout by improving water quality and animal welfare conditions[5].

Indeed, organic farmers producing trout tend to avoid treatments in the hatcheries within 18 months, which is one reason of higher mortalities, because they cannot schedule in advance the whole duration of the production cycle of the fish (e.g. trout can be sold or over 30 months of rearing, according to market demand).

2.14.2. Reflections of the group

The EGTOP group takes the request of a member state "to harmonize the threshold for parasitic treatments to that for allopathic treatments (i.e. once a year with a life cycle < 12 month and twice a year with a life cycle >12month)" as an opportunity to principally look into the matter of disease/parasite treatments in organic aquaculture.

Health management in organic livestock and aquaculture is principally organized in form of a cascade control scheme. First, preventive measures shall be put in place to avoid the outbreak of diseases or parasites. If diseases or parasites occur, phytotherapeutic and/or homeopathic treatments shall be preferably applied. If not effective, allopathic treatments are permitted as long as they are prescribed and supervised by a veterinarian. Regarding ectoparasites in organic aquaculture (namely, sea lice in organic salmon farming) the regulation recommends using cleaner fishes, or bathing of fishes in fresh or marine water. For the integrity of organic fish, it is important that fish farmers really implement the cascade control system before applying allopathic treatments. According to the group opinion, the relevance of monitoring the practical implementation of health management plans by the accredited certification bodies should be

[5] http://icrofs.dk/en/research/danish-research/organic-rdd-4/shelterfish/

emphasized. The final objective is to avoid allopathic/antiparasitic treatments whenever possible and not to make use of it just because it is allowed.

Unlike for organic aquaculture all other organic livestock are under a slightly different regime[6,7]. In this context EGTOP recommends harmonizing the organic regulation for farmed aquatic animals and animal husbandry.

Higher sea water temperatures (a consequence of global warming) led to an increasing problem with sea lice in all salmon farming regions in Europe. Therefore, the conventional salmon farming industry has resorted to a number of sea lice treatment methods over time. The mix of treatments is important as sea lice become resistant against chemical drugs like emamectin or synthetic pyrethroids, organophosphates like the widely used azamethipos (Grant, 2002; Urbina et al., 2019).

Cleaner fish (e.g. goldsinny wrasse, ballan wrasse, corkwing wrasse, rock cook, lumpsucker) are part of the treatments mix in many salmon farms, both organic and conventional. As a consequence, increasing wild catch of cleaner fishes has led to an overexploitation of this species in some areas. The aquaculture production of cleaner fishes is growing but still the industry depends on wrasses fisheries. In the group's opinion, it is important that cleaner fishes used in organic salmon farms are either from aquaculture or from sustainably managed fisheries (Tett et al., 2018). Moreover, the welfare status of cleaner fishes should be the subject of further study.

Major differences exist between extensive and semi-intensive organic aquaculture production systems, as well as differences exist between reared finfish and crustacean. In organic shrimp farming, for example, the use of antibiotics and other allopathic medicines or parasitic treatments is not needed. Therefore, in the group's opinion, a uniform regulation of disease treatments over all species and production systems is not appropriate.

2.14.3. Conclusion of the group

The group acknowledges the problem highlighted by a MS of high mortalities in organic trout hatcheries. However, in the group's opinion, it would be more appropriate to define specific restrictions for the parasite treatments, based on species and/or production systems.

The group recommends allowing parasite treatments for salmon once a year when the production cycle is < 18 months and twice a year when the production cycle is > 18 months, only in the case that the salmon farm already uses cleaner fishes in the cages, and provided that cleaner fish shall be from sustainably managed fisheries or from aquaculture operations. Whatever the length of the production cycle, no more than 4 treatments can ever be administered.

The group recommends allowing parasite treatments for trout once a year when the production cycle is < 12 months and twice a year when the production cycle is > 12 months, but never more than 4 treatments in total.

For other organically farmed species the provisions adopted for the trout will be applied, until further scientific and/or empirical evidence intervenes.

The group recommends banning parasite treatments with chemically synthesized allopathic medicinal products in the grow-out stages of aquaculture animals, as referred to in Annex XIIIa, Section 6, Section 7 and Section 9 of the Regulation (EC) No. 889/2008. However, if chemically

[6] Commission Regulation (EC) No. 889/2008, Article 24, Paragraph 4.
[7] Regulation (EU) 2018/848, Annex II, Paragraph 1.5.2.4.

synthesized allopathic medicinal products are applied as parasite treatment, then it falls under the limitation of the maximum number of allowed allopathic treatments[8] (compulsory national schemes for parasite treatments are not counted).

Above all, the group would welcome a survey among MSs to ascertain the use of allopathic / parasitic treatments (frequency and type of parasite treatments) in organic aquaculture (possibly including other terrestrial animals as well).

2.15. Pending questions from EGTOP report 2018 on Fertilizers III

2.15.1. General considerations

Article 6d of Regulation (EC) No 889/2008 currently allows only nutrients of plant or mineral origin for seaweed production. The two pending questions are:

1. Should nutrients of animal origin be allowed for production of microalgae and/or seaweed?
2. Should stripped nitrogen be allowed for production of microalgae and/or seaweed?

Seaweed and microalgae in the current regulation
Although regulated equally in the current organic regulation (Article 6a of Regulation (EC) No 889/2008), the group sees a significant difference between macroalgae (seaweed) and microalgae. Besides biological differences, nowadays freshwater and marine water microalgae are produced in closed and land-based aquaculture systems only (e.g. ponds, raceways, tanks, tubes etc.). Whereas most of the commercially relevant macroalgae are from marine origin and cultivated in open marine aquaculture systems on lines, nets, ropes and racks.

Open systems/closed systems
Fertilization of cultivated macroalgae/seaweed is not permitted in open systems neither with nutrients from plant production nor from animal production. Except in polyculture systems combining for example the production of finfish, shellfish and macroalgae (so-called IMTA - Integrated Multi-Trophic Aquaculture Systems) excretions from fed fish are used as nutrients for filter feeding organisms and algae[9]. To avoid any misunderstanding, the first question should be re-formulated as follows: "Should nutrients of animal origin be allowed for production of seaweed and/or microalgae in closed and land-based systems?".

Photobioreactors
Worldwide only a few commercial microalgae farms are based on 100% closed systems. None of them are certified according to the EU organic regulation. However, some of them could become relevant as suppliers of feed ingredients for organic aquaculture. For example, the company AlgaTech in Israel producing Astaxanthin from a microalga called *Haematococcus pluvialis*. The latter has received NOP certification[10]. Another example is the Veramaris production of algae oil from the marine microalgae *Schizochytrium sp.*. This microalga has a high content of omega 3 fatty acids EPA and DHA and has the potential to partially replace fish-based ingredients for a variety of species[11]. Both these algae are produced in photobioreactors in highly technical and industrial scale plants. In this regard it is useful to highlight that using nutrients from organic plant/animal materials is challenging for production in photobioreactors, as light transmissivity is affected by a film of dirt (in tubes, plastic bags

[8] Vaccination are excluded from the calculation of the maximum number of allowed allopathic treatments.
[9] About IMTA see more details in the OrAqua Report: Deliverables 6.2 Technical Background behind the recommendations.
[10] https://www.algatech.com/algatech-obtains-organic-certification-for-astapure-natural-astaxanthin/
[11] https://www.veramaris.com/what-we-do-detail.html#omega3

etc.). This effect doesn't occur using, for example, urea (from stripped Nitrogen) or other chemical-synthetic fertilizers.

Source of nitrogen
The group agree with the statement in the EGTOP report 2018 on Fertilizers III: "*… organic farming should not be the dumping place for conventional farming and municipal wastes, and that consumers might be concerned about the use of such materials*". Thus, nitrogen stripping should not become "the door opener" for nitrogen from unsustainable and/or industrial forms of animal production. However, the stripping technology can also be applied e.g. for recovery nitrogen from organic animal husbandry, or sewage sludge from wastewater treatment plants, etc. Recycling of nutrients (the concept of the circle economy) belongs to the basic pillars of organic farming and food production. Indeed, organic spirulina[12] producers use nitrogen above all from fermented food/feed grade organic soybeans to feed microalgae. Although it should be noted that the fermentation process reduces the water efficiency of spirulina production, compared to the use of urea or other forms of highly soluble nitrogen.

N-Stripping Technology
The N-Stripping technology is a still young technology with space for increasing the performance. Characteristic of the technology is a high-energy consumption for the nitrogen recovery (heating the system, electrical energy for pumping, etc.). Figures from one EU-funded research project have calculated the total primary energy demand in an ammonia stripping plant with 32 kWh per kg of recovered nitrogen[13,14]. On the other hands, recovery of nitrogen has the positive side effect that the amount of strong greenhouse gases like N_2O will be reduced at the same the time.

Food safety
If nitrogen sources from animal production (or sewage sludge) would be used for feeding microalgae like Spirulina a certain risk of microbiological contamination of the final product (e.g. Salmonella, E. coli, etc.) exists. The same risk is addressed for organic plant production in Annex I of Regulation (EC) No. 889/2008 where the application of some nutrients from animal origin on edible parts of a plant is prohibited.
The microalgae are normally filtered and dried and can be directly used for human consumption. In the "Good Agriculture and Collection Practices (GACP)" written for medicinal plants animal manure should be thoroughly composted and should be void of human faeces"[15]. Even conventional Spirulina producers do not often use nutrients from animal origin if spirulina production is for pharmaceutical products.
The use of Ammonium-Sulfate (as a liquid fertilizer) originating from N-Stripping of liquid animal manure (or sewage sludge) would avoid any problem of microbiological contamination due to the stripping process (physical separation between the liquid and NH_3 – gas).

2.15.2. Reflections of the group and conclusion

The following conclusions refer to seaweed/macroalgae and microalgae production in land-based systems (e.g. outdoor raceways, ponds, tanks), partially/full closed systems, greenhouses and photobioreactors. While, the current regulation should be maintained for macroalgae (seaweed) cultivated in open marine aquaculture systems.

For cultivation of macroalgae/microalgae/cyanobacteria, nutrients from terrestrial animal origin should be permitted, with the restriction reported in the Annex I of the Regulation (EC) No.

[12] See Annex 3 - Short note on spirulina
[13] See Figure 7 in http://powerstep.eu/system/files/generated/files/resource/d-4-3-operation-and-optimization-of-membrane-ammonia-stripping_0.pdf
[14] The Haber Bosch process requires about 0.6 kg of natural gas (or 7.5 kWh) to produce 1 kg N.
[15] http://apps.who.int/medicinedocs/en/d/Js4928e/

889/2008 and provided that any microbial contamination of the final product can be avoided.

All efficient and environmentally friendly technologies for nutrient recycling are welcomed, therefore the group is not against permitting the N-Stripping technology, if animal nutrients from factory farming are excluded. The integrity of organic food/feed will not be undermined by allowing N-recovery from animal manure, biogas digestates as listed in Annex I of the Regulation (EC) No. 889/2008. Food/feed safety concerns can be addressed by a functioning quality control system with regular microbiological testing of the source of animal nutrients.

Ammonium sulfate originating from N-Stripping has a high solubility which is not in line with the organic principles for crop production (as highlighted in EGTOP report Fertilisers III). In order to avoid any misunderstanding, the use shall be restricted to macro-/microalgae production in closed and land-based systems.

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4. ANNEX 1 - List of items to be addressed

1. Review of current stocking densities

Stocking densities for the main species or groups of species, other than molluscs, are established in Annex XIII(a) to Regulation (EC) No 889/2008. Article 25f(2) of the Regulation states that "*in considering the effects of stocking density on the welfare of farmed fish, the condition of the fish (such as fin damage, other injuries, growth rate, behaviour expressed and overall health) and the water quality shall be monitored*." Regulation (EU) No 2018/848, which will be fully applicable from January 2021 confirms the objectives, principles and requirements of organic aquaculture.

In the context of the discussion held in the Committee on organic production concerning the measures to be taken under Article 15(3) of Regulation (EU) No 2018/848 with respect to detailed rules per species or per group of species on the stocking densities and on the specific characteristics for production systems and containment systems in order to ensure that the species specific needs are met, several Member States proposed to review for some species the current maximum stocking density levels set under Annex XIII(a) to Regulation (EC) No 889/2008.

The approaches proposed by the Member States are the following:

1.1. Proposals to increase stocking densities for the group " freshwater salmonids", Salmon, Rainbow trout and Arctic charr, excluding Brown trout (see current Section I of Annex XIII (a) of Regulation (EC) No 889/2008)

- Few MS proposed to align the stocking density set for the group "other freshwater salmonids species", excluding salmon, in line with the stocking density set for `rainbow trout (*Onchorhynchus mykiss*) and brown trout (*Salmo trutta*) (25 kg /m^3), this would mean in practice to increase for this group from current 15 kg/m^3 to 25 kg/m^3.
- One **MS** proposed an increase of the maximum stocking density for rainbow trout (*Onchorhynchus mykiss*) to 35 kg/m^3 for large animals. Recalling the effect of density on trout welfare, it was underlined that studies show that a too low density has harmful effects on the well-being of trout. Citing the study by B. P North "*with 80 kg/m^3 subject to good water quality, it is possible to raise trout without compromising physiological indicators of good growth or growth*". The MS concluded: "*in order to strengthen the economic viability of aquaculture farms while not degrading the welfare conditions of the animals, call for the passage to 35 kg/m^3 for trout, which would also apply to the Arctic charr*".
- A **MS** expressed its disagreement with the above proposal which is considered to be driven by economic and not by health and welfare reasons.
- A **MS** suggested that for Arctic charr (*Salvelinus alpinus)* the set maximum density at 25 kg/m^3 is too low for optimal fish welfare, and suggested increasing this to 40 kg/m^3. It referred to scientific studies showing that too low density in production of Artic charr is negative for the fish welfare (increased aggression and increased mortality).

"According to Baker and Ayles (1990), the optimal stocking density for charr is about 40 to 60 kg/m^3 when fish health and economic yield is taken into consideration, compared with 10 to 25 kg/m^{3}for other salmonids. Furthermore, Siikavuopio and Jobling (1995) reported that charr kept at 30 kg/m^3 had more fin damages and higher weight losses than those kept at 90 and 150 kg/m^3". It cited also the researchers, Albin Gräns and Eva Brännäs (both Swedish University of

Agricultural Sciences) who emphasized that “Arctic charr kept in low densities show chronic stress due to interactions with their conspecifics.” In addition, it underlined that “Increased growth, less cortisol levels (stress hormone) and less physical damage are central objectives for responsible animal breeding. When they are kept in higher densities (40-60 kg/m^3), they will develop school behaviour and not cause each other injuries. School behaviour is natural to Arctic charr and organic animals should be kept according to their species-specific needs and in a way that prevents suffering.”

- Another **MS,** supporting the proposal to increase the density of Arctic charr, underlined that “Arctic charr appears to be more sensitive to low densities and there is evidence to suggest that, when reared at densities under 30-40 kg/m^3, Arctic charr demonstrates increased aggression and lower growth rate. Both these responses suggest increased stress levels at low density. When water quality is secured there is no evidence of decreased growth rate at densities between 40 to 100 kg/m^3, suggesting that the fish are not stressed (Wallace et al., 1988; Brown et al., 1992; Christiansen et al., 1992; Jörgensen et al., 1993, Siikavuopio and Jobling 1995; Alanära and Brännäs, 1996; Metusalach et al., 1997; Brännäs, E. & Linnér, J. 2000).” The conclusions according to it should be that a maximum stocking density of 60 kg/m^3 would be acceptable for organic production of Arctic charr.
- **One MS** proposed to increase the stocking density for salmon in fresh water from 20 to 30 kg/m^3 and considered this would represent the 50% of non-organic salmons units. **A MS** expressed its disagreement on this proposal and underlined that freshwater stage of salmon is limited to smolts production and is confined to nurseries and hatcheries. The same MS believes that set stocking density (current Section 1 of Annex XIII (a) of Regulation (EC) No 889/2008) is referring to on-growing farm systems and not to smolts production.
- Another **MS** proposed to increase the stocking density for Arctic charr from 25 to 40 kg/ m^3.

1.2. Proposal to increase stocking densities for Salmon, Brown trout and Rainbow trout in sea water (current Section II of Annex XIII (a) of Regulation (EC) No 889/2008)

- Some **MS** proposed to increase the stocking density for salmonids in sea water Salmon *(Salmo salar)*, Brown trout *(Salmo trutta)* and Rainbow trout *(Oncorhynchus mykiss)* from 10 kg/m^3 in net pens to 12,5 kg/m^3.

1.3. Proposal to increase stocking densities for several species on the basis of “size” approach (current sections I , III, V and IX of Annex XIII (a) of Regulation (EC) No 889/2008)

- **One MS** proposed a completely new approach, based on size of the fish for several species as follows:

Current Section I: Organic production of salmonids in fresh water

Brown trout *(Salmo trutta*) — Rainbow trout *(Oncorhynchus mykiss)* — American brook trout *(Salvelinus fontinalis)* — Salmon *(Salmo salar)* — Arctic charr *(Salvelinus alpinus)* — Grayling *(Thymallus thymallus*) — American lake trout (or grey trout) *(Salvelinus namaycush)* — Huchen *(Hucho hucho)*

Maximum stocking density	Salmonid species not listed below: 20 kg/ m^3 for fish with individual weight < 2 kg, 10 kg/m^3 for fish with individual weight ≥ 2 kg Salmon: 20 kg/m^3 for fish with individual weight < 2 kg, 10 kg/m^3 for fish with individual weight ≥ 2 kg Brown trout and Rainbow trout: 20 kg/m^3 for fish with individual weight < 2 kg, 10 kg/$m^3$for fish with individual weight ≥ 2 kg Arctic charr: 20 kg/m^3 for fish with individual weight < 2 kg, 10 kg/m^3 for fish with individual weight ≥ 2 kg

The following are background considerations for the above proposal:

"At low density the growth, food consumption and feed conversion of brook trout are better (Vijayan and Leatherland, 1988).

A low stocking density between 15 and 19 kg/m^3, as in the Dumas et al. (1995b), suits the brook trout welfare. From a stocking density of more than 40 kg/m^3 in the conventional tanks, the welfare of the fish was hardly affected. The animals used the diet badly or poorly (feed quotient 1,83 in pools 1 and 1,78 in pool 2). Since the conventional could not be further intensified, the fish quantity in the 26. Test week (KW 9 2003) was reduced to a density of 13 kg/m^3. After that, the FQ improved again to 0,85. Assuming that it has sufficient oxygen and good water quality, the rainbow trout shows lower appetite with growing density and a slight decrease in the growth performance. The reason for this is the natural reaction of the fish to their denser swarm or larger population. The somewhat better Feed Quotient of the biological production in the present experiment, according to Boujard et al.(2002) is related to the lower stocking density (Pereira de Azambuja, T. & Reiter, 2006). The same source mentions that species-appropriate low stocking densities imply for the consumer that the farmed trout grows up in one of the free-living almost identical environment. The publication provides also that the decision for an environmentally certified standard contributes actively to the protection of the environment. Currently, the ecological problem of salmonid breeding is postponed: the nutrient load in indigenous waters will be increased to the benefit of the conservation of the world fish stocks. Half of the surveyed bio-buyers consider to make a direct contribution to protecting the environment through the added price (Pereira de Azambuja, T. & Reiter, 2006). In addition, from organic holdings: design of the ponds is also essential, i.e. whether fish have the possibility to escape the aggressor (by depletion, semi-natural soil, etc.) and this regardless of the stocking density."

One MS expressed its disagreement with above-mentioned proposal for salmon in freshwater expressing the consideration that salmon smolts should be outside of the scope of current Section 1 of Annex XIII (a) of Regulation (EC) No 889/2008. It proposed that "*maximum stocking density for freshwater salmonid salmo salar is removed or qualified by adding 'excluding salmon smolt production*".

Section II: Organic production of salmonids in sea water

Salmon (Salmo salar), Brown trout (Salmo trutta) — Rainbow trout (Oncorhynchus mykiss)

Maximum stocking density	10 kg/m^3 in net pens

Same MS supported the current set level (as above table) on the basis of the following:

“A very important aspect to consider is the spread of diseases that can be transmitted from farmed salmon to wild stocks. This includes in particular the salmon louse and other diseases transmissible (e.g. infectious salmon anemia (ISA)). Numerous studies show that health and survival rates are negatively correlated with the number of salmon farms and production. The level of production for a particular area (bay), which is also used by wild salmon as migration routes, is also a decisive factor.

An increase in stocking density to 20 or 30 kg/m^3 results in a corresponding double or tripled pollution of the seabed with organic sediment (especially in open systems there is hardly any possibility of filtering).

The transmission of disease within the net enclosure is also facilitated at higher stocking densities and the medium / host count of a particular pathogen is increased. This promotes mass outbreaks of certain diseases. At the same time, the number of drugs required increases with the number of animals kept.”

A list of reference studies has been transmitted and is included in Annex to this document.

Section III: Organic production of cod (Gadus morhua) and other Gadidae, sea bass (Dicentrarchus labrax), sea bream (Sparus aurata), meagre (Argyrosomus regius), turbot (Psetta maxima [= Scopthalmus maximux]), red porgy (Pagrus pagrus [= Sparus pagrus]), red drum (Sciaenops ocellatus) and other Sparidae, and spinefeet (Siganus spp.)

Maximum stocking density	For fish other than turbot: 20 kg/m^3 for fish with individual weight < 2 kg, 10 kg/m^3 for fish with individual weight ≥ 2 kg` For turbot: 20 kg/m^2 for fish with individual weight < 2 kg, 10 kg/m^2 for fish with individual weight ≥ 2 kg

Section V: Organic production of Sturgeon in fresh water

Species concerned: *Acipenser* family

Maximum stocking density	20 kg/m^3 for fish with individual weight < 2 kg, 10 kg/m^3 for fish with individual weight ≥ 2 kg

Section IX: Tropical fresh water fish: milkfish *(Chanos chanos)*, tilapia *(Oreochromis spp.)*, siamese catfish *(Pangasius spp.)*

Maximum stocking density	Pangasius: 20 kg/m^3 for fish with individual weight < 2 kg, 10 kg/m^3 for fish with individual weight ≥2 kg Oreochromis: 20 kg/m^3 for fish with individual weight < 2 kg, 10 kg/m^3 for fish with individual weight ≥ 2 kg

- Finally, **one MS** underlined that the proposed stocking densities are approaching the levels of conventional aquaculture and could lead to higher disease pressure and water quality problems.

2. Stocking density, production and containment systems for new species

In the context of the discussion held in the Committee of organic production on the measures to be taken under Article 15(3) of the Regulation (EU) No 2018/848 some Member States proposed the inclusion to Annex XIII(a) to Regulation (EC) No 889/2008 of new species of fish. In the light of the most recent technical and scientific information available to the experts, the Group is invited to examine whether and how the new proposed species below, could be raised in organic aquaculture production schemes. Taking into account the welfare of farmed fish, the group should address for these new species the most appropriate stocking densities and husbandry practices and any other relevant specific aspects of production as established for other species in Annex XIII(a) to Regulation (EC) No 889/2008:

- **A MS** proposed to add the species ***Lota lota*** **(Burbot)** with a maximum stocking density of 25 kg/m^2.
- **Another MS** proposed to add the species **Perca fluviatilis (Perch)** to be reared in monoculture system in constructed ponds. “Restricting the production of organic perch (a carnivorous and shoaling species) to a polyculture system is an impediment to the further expansion of organic perch production. Consideration should be given to developing organic production rules for perch in line with other shoaling species e.g. trout, charr, with associated maximum stocking density”.

3. Permitted feed sources and feed additives

The following proposals have been put forward by Member States experts in the context of the discussion held in the Group of Experts during the drafting of the delegated act pursuant to Article 15(2) of the new Regulation (EU) No 2018/848, in particular:

3.1. Set a maximum percentage for fishmeal and fish oil for carnivorous aquaculture animals

- **A MS** proposed to define a maximum percentage for fishmeal and fish oil for carnivorous aquaculture animals. In particular, it was underlined "*use of fishmeal and fish oil derived from whole fishes should be limited to critical nutrition situations (e.g., histidine deficiency in young salmon). Fishing for fishmeal is one of the critical points in contemporary aquaculture and should be clearly limited for reasons of sustainability in the organic production as far as possible.*" Hence, the proposal would imply to add that the maximum percentage of fish meal and fish oil from sustainable fisheries **shall not exceed 30%** of all feed ingredients over the complete life span of the animals.
- **A MS** disagreed with the emphasis considering that fishing for fishmeal and fish oil from unsustainable fishing is the critical point. "*Fishmeal and oil derived from whole fish can be as sustainable as any other terrestrial production means that source nutrients for organic aquaculture feed (or just as unsustainable). This includes land protein as well as marine. The emphasis should be placed on qualified sustainable sources and then define what qualified means. For agriculture, this refers to organic certification. For fisheries, this should be from certified sources such as MSC certification or IFFO RS or equivalent. Use of trimmings/offals can be encouraged, but these too should be of qualified origins. Is the 30% derived from available data? Suggested proposal: 'A max % of "whole" fish meal and fish oil from sustainable fisheries shall not exceed 30%. It should not include trimmings meal and oil.'*"
- **Same MS** brought the attention to the fact that the limitation of any feed ingredient should consider "firstly, it is not compromising fish welfare; secondly, it not compromising organic product quality - organic salmon should be high in Omega 3 content – of the right variety which means the sector should not be restricted in choice of ingredients (already we are seeing omega 3's in land animals increasing and yet in conventional salmon our practice of moving to land protein substitution is reducing it to lowest levels ever). And thirdly, choose organic/sustainable choices where possible. Only in the absence of the latter, should there be restrictions on quantity of non-certified sources." It underlined that emphasis needs to move to welfare, fish quality (focus on the consumer) and sustainable sources of all ingredients.
- **One MS** expressed concern about the proposal on limitation of 30% fishmeal in the organic feed for carnivorous aquaculture animals, which cannot be supported when no alternative solution is available. "*At least the double amount is used in the organic fish feed for salmon today (50-80% marine ingredients depending on the feed quality needed in different production stages). This includes trimmings, whole fish and fish oil. We are lacking sufficient alternative ingredients to ensure the feed quality for optimal fish health and welfare. We would like to refer to the reports from the OrAqua project with scientific knowledge about organic fish feed (European Organic Aquaculture - Science-based recommendations for further development of the EU framework and to underpin future growth in the sector)*". In particular, it brought the attention to the following points:
  - Regulation (EC) No 889/2008 does not allow fish meal and fish oil derived from traditional industrial fish, but only from trimmings of fish from organic aquaculture or from trimmings or whole fish of fish already caught for human consumption in sustainable fisheries, in order to prevent reductions in fish stocks.
  - There is a prohibition to use fishmeal made from the same species.
  - Regulation (EC) No 834/2007, Art. 15 (d) with regard to feed for fish and

crustaceans states that "Animals shall be fed with feed that meets the animal's nutritional requirements at the various stages of its development".

- Fish meal of high quality provides a balanced amount of all essential amino acids, minerals, phospholipids and fatty acids reflected in the normal diet of fish (Hardy, 2010; Lund et al., 2012), and hence, secure high utilization by the fish and minimum discharge of nutrients to the environment.
- Replacing fish meal in diets for salmonids and marine species is not straightforward due to their unique contents of protein, excellent amino acid profile, high nutrient digestibility, high palatability, adequate amounts of micronutrients, as well as general lack of anti-nutrients in fish meal (Gatlin et al., 2007; Kaushik and Seiliez, 2010; Krogdahl et al., 2010; Lund et al., 2012).
- Supplementation with synthetic amino acids is not allowed according to Regulation (EC) No 834/2007 Article. 15 1d. (IV) and currently no amino acids are listed in Annex VI to Regulation (EC) No 889/2008. Furthermore, procedures for the removal of anti-nutrients have to follow organic rules. Finally, there is less availability of relevant organic plant sources to optimize the amino acid profile in comparison to conventional plant sources (Lund et al., 2011; Rembiałkowska, 2007).
- Farmed fish need a balanced dietary amino acid profile and especially essential amino acids have to be provided in the diet in specific proportions. If this is not the case the surplus amino acids will be burned off and the result is compromised fish welfare and environmental impact conflicting the organic principles.
- Plus in the final ORAQUA reports which are listed in Annex the following recommendations are included: 1. Fish meal and fish oil derived from non-organic aquaculture trimmings 2. Essential amino acids produced through fermentation 3. Exceptional production rules allowing the use of non-organic feed.

- **Another MS** shared the above concerns and do not support the limitation due to the lack of sufficient alternative ingredients to ensure the feed quality for optimal fish health and welfare. Information received suggests that fishmeal and fish oils are included at around 50-80%. There is currently no alternative ingredient available that could replace the shortfall should a limit of 30 % be imposed. Further considerations from the sector are available in attachment.
- **A MS** underlined that "if the emphasis is placed on sustainable sources, the objective of limiting the use of fishmeal and fish oil is not one related to sustainability. If the argument relates to fishing for feed rather than for direct human consumption, this is more about resource utilisation, raw material suitability, market preferences (particularly for small pelagics) and not a sustainability argument."

3.2. Specific rules on feed for certain aquaculture animals

3.2.1. Flexibility within the overall limits of 35% for fishmeal and fish oil for *paeneid* shrimps and prawns

- **A MS** proposed to consider whether the feeding of *paeneid* shrimps and prawns could be reviewed and amended to allow more flexibility within the overall limit of 35% of fishmeal and fish oil from sustainable fisheries, instead of applying the threshold of 25% of fish meal and 10 % of fish oil. The aim would be to provide a better protein balance intake for these carnivorous animals.

3.2.2. Set a maximum percentage for fishmeal and fish oil for tilapia (*Oreochromis* spp.)

- **One MS** proposed to add a maximum percentage of fishmeal or fish oil derived from sustainable fisheries not only for catfish (*Pangasius* spp) but also for tilapia (*Oreochromis* spp). It underlined that the current legal framework led to a situation where there is no organic tilapia production. "*Since tilapia has similar demands in feed as pangasius, the feeding should also be designed accordingly*". Consequently, it proposed that the diet for tilapia might consist of a maximum of 10% of fishmeal or fish oil derived from sustainable fisheries.

3.2.3. Feeding requirements for carp family

- **A MS** proposed to define feeding requirements for Carp family *(Cyprinidae)* by maximum percentage of fishmeal at 20% and fish oil at 10% with fishmeal and fish oil derived from sustainable fisheries. "*The aim would be to produce fishmeal and fish oil from non-food parts of other fishes from sustainable fisheries for the purpose of feed production for organic carps. Due to very small amount of polyunsaturated fatty acids in the freshwater environment, the use of fishmeal and fish oil, rich in omega-3 fatty acids, in feed for organic carps will allow rearing carp with meat of better quality containing protein derived from sustainable fisheries.*" It also underlined that the current legal framework determines specific rules on feed for carnivorous aquaculture animals, while Carp family is omnivorous species and not clear whether subject to provisions laid down for carnivorous aquaculture animals.

3.2.4. Fish in inland waters

- **One MS** asked to consider the following: "there are very restrictive rules set up for 'fish in inland waters'. We understand that those rules are not applicable for extensive aquaculture in large water (as lakes, etc.) and are not for carnivorous animals." The MS asked for a definition of 'ponds' and 'lakes' and an opinion on "whether the rules provided for should apply to extensive farming, poly-production (potentially specifying the species concerned), large bodies of water, or to limit these rules to natural bodies of water".

3.3. Organic insects for aquaculture animals

- **One MS** proposed to add among the priority sources of feed for carnivorous aquaculture animal the organic insects produced for feed, given that they are a more sustainable source of proteins for carnivorous fish than fishmeal "*with a 30% less impact on climate change and no impact on oceanic resources*". Evidence is going to be provided.
- Another **MS** asked to consider whether it would not be important to have an harmonized approach and allow authorization for the use of non organic insects for a limited period to set as long as enough organic insects will be available on the market.
- **One MS** wondered whether literature that substantiates the statement regarding 30% less impact is available. "This should only be the case if the insect meal is a suitable food source for the animal in terms of nutritional requirements and if there are sustainable supplies available. Currently not enough is known about the role of such meal as a food source for fish and commercially supplies are low."
- **A MS** underlined that further limitation of the proportion of fish meal and fish oil is to be supported, but at the same time alternative sources of protein (e. g. insects) must be

intensively researched or further developed.

4. Veterinary treatments for aquaculture animals

The following proposals have been put forward by Member States experts in the context of the discussion held in the Group of Experts during the drafting of the delegated acts pursuant to Article 15(2) of the new Regulation (EU) No 2018/848 in particular with respect to veterinary allopathic treatments:

4.1. Measures to limit the use of allopathic treatments for invertebrates

- **A MS** proposed to add the following requirement under point 3.1.4.2.: *"After use of allopathic medicines, the absence of residues in the end product must be proven by suitable analysis."* It considered that points (d) to (g) under 3.1.4.2. do not limit the application of allopathic treatments effectively. In particular, in view of the frequent antibiotic findings in imported conventional aquaculture products, it would be important, also to identify other measures to limit the use of allopathic treatments for invertebrates.

4.2. Review of number and frequency of parasites treatments for juveniles of rainbow trout

- **A MS** reported serious problems of occurrence of parasites in organic juveniles of rainbow trout resulting in mortality rates of up to 60%. Considering also the animal welfare objective, it was proposed to allow for the possibility to apply the necessary veterinary treatments of organic juveniles, which could be set for the individual species i.e. trout and salmonids during the first 3 months of life; or to change the maximum number of parasite treatments, other than through compulsory control schemes operated by Member States, to be limited to twice per year, or once per year where the production cycle is less than 12 months instead of the current 18 months. Indeed, MS informed that "*for species with a more or less fixed production cycle of less than 18 months the current rules could make sense. But for species like rainbow trout where the production cycle can differ from typically 14 – 36 months, the 18 months demand is a challenge. A fry/fingerlings producer of rainbow trout currently does not know if it is allowed to treat rainbow trout infected with parasites once or twice per year because he cannot predict at what age the slaughtering will take place.*" Moreover, it was underlined that using 12 months, as a threshold, would be consistent with the general rules of use of allopathic treatments.

5. Pending questions from EGTOP report 2018 on fertilisers III

The group is asked to address the two questions expressed under point 3.5.2 of EGTOP report on Fertilisers III of June 2018 concerning nutrition of *Arthrospira* (spirulines) and other micro-algae.

5. ANNEX 2 - List of studies/documents submitted or cited by Member States

Submitted and available in attachment

- Input organic whole fishmeal
- ORAQUA D6 1 Final Recommendations
- ORAQUA D6 2 Technical background
- ORAQUA D2 1 Review

List of reference studies

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6. ANNEX 3 - Short note on spirulina

Spirulina

'Spirulina' is the trade name used for products from the two (cyanobacteria) genera Arthrospira and Spirulina. Worldwide, the species *Arthrospira platensis* is the most widely produced species. Although, not a micro-alga (microalgae belong to the eucaryotes, cyanobacteria to the procaryotes) spirulina products are promoted as originating from microalgae in global markets (in the following the authors will use the term microalgae also for Spirulina species). Like genuine microalgae (for example the freshwater based Chlorella) and macro-algae (seaweed) all spirulina species are photoautroph (realizing an oxygen producing photosynthesis). The use of Spirulina for human consumption has a long tradition in different regions of the world (by the Aztecs in Mexico or by the Kanembu population near Lake Chad collecting the microalgae in natural lakes).

Advantages of microalgae

Microalgae are a promising protein and nutrient source for the future, for food and feed use. In particular "Spirulina" species can be produced on non-fertile (saline/alkaline) areas in tropical and sub-tropical areas offering food and income opportunities. Compared to traditional terrestrial crops the ecological footprint can be much lower regarding the water use, land occupation and energy consumption (for example Spirulina needs only 25% of the water needed to produce one kg protein from soybean, or only 2% of the water needed for the production of one kg protein from beef)[16]. Some health effects have been reported on humans (suppressing anemia and immune-senescence in older subjects, and anti-bacterial and skin care effects when using fermented spirulina), however scientific proof is hard to find. In Africa small-scale Spirulina production is among others promoted to combat AIDS/HIV[17,18].

Current organic regulation

The organic production of macro-algae and/or microalgae for feed and food is already covered by the EU regulation, including their nutrition. Organic production of both is possible under the current rules but according to Article 6d**,** Commission Regulation (EC) No 889/2008 only nutrients of plant or mineral origin are permitted. Some certification bodies have developed complementary standards looking among others into food safety issues[19]. The latter is important as Spirulina and Chlorella are often directly used for human consumption (after filtering and drying).

Prevailing production systems

The lion's share of conventional and organic Spirulina and Chlorella production takes place in open, fresh-water[20] production systems, mainly in Asian countries (above all in India and China). Some of the organic producers highlight that their products are "vegan" and no products/by-products from animal production are used. Due to the climatic situation in Europe (and other regions) open systems are not viable. Only closed systems are feasible to control the temperature. In France, Spirulina producers have emerged in the last 15 years and formed a producer association[21]. They are producing Spirulina in green houses and have developed a fertilization scheme allowing nutrients from animal origin (e.g. urine or manure) among others. Although the French Spirulina cannot be certified according to EU organic production rules it is widely recognized and often certified by private standards (e.g. Ecocert).
Alternatively, microalgae can be kept in photobioreactors to optimize light/solar conditions,

[16] https://www.natgreen.it/media/attachments/2018/07/24/spirulina_the_beneficial_algae.pdf
[17] Spirulina- A Livelihood and a Business Venture (www.fao.org/3/a-az386e.pdf);
[18] https://academic.oup.com/jnci/article-abstract/81/16/1254/969523?redirectedFrom=fulltext
[19] Ceres Policy on Microalgae: http://www.ceres-cert.com/portal/index.php?id=67#micro
[20] Principally, Spirulina can grow also in saline water but with much lower cell growth due to the osmotic stress.
[21] http://www.spiruliniersdefrance.fr/spip.php?article558&lang=fr

one of the decisive growing factors for microalgae. Using nutrients from organic plant/animal materials is challenging for production in photobioreactors as light transmissivity is affected by a film of dirt (in tubes, plastic bags etc.). This effect doesn’t occur using for example urea (from stripped Nitrogen) or other chemical-synthetic fertilizers.