

FISH FEED AND PROCESS FOR PRODUCING THE SAME

This invention relates to a fish feed comprising an additive which is a mixture of Dunaliella alga powder and a cyclodextrin, and to a process for producing the fish feed.

There is known a feed containing Chlorella algae (green algae) (JP-A-131894/1974), a feed additive comprising Spirulina algae (blue-green algae) (JP-A-10017/1981) and a feed composition comprising Dunaliella algae (green algae) as the active component. These feed compositions have been used to improve the body colour of prawns.

The invention provides a powdery, granular or pellet-like fish feed comprising:

(a) an additive comprising dried Dunaliella algae and a cyclodextrin in a weight ratio of 100:15 to 100:50,

(b) a conventional fish feed, in which the weight ratio of (a) : (b) is 1:20 to 1:50.

In this invention, the Dunaliella alga powder is adsorbed by cyclodextrin in order to stably maintain the oily β -carotene during storage of the fish feed and during production of the fish feed. The cyclodextrin is used in an amount of 15 to 50 parts by weight per 100 parts by weight of the Dunaliella alga powder. This is because no adsorption is observed by using less than 15 parts by weight of cyclodextrin,

while the adsorption effect is not further improved by using more than 50 parts by weight and this would therefore be disadvantageous from an economical viewpoint.

In the invention, 1 part by weight of the fish feed additive (a) is blended with 20 to 50 parts by weight of a conventional fish feed (b). This is because the effect of the additive is not further improved when more than 1 part per 20 parts of conventional fish feed is used, and this would therefore be disadvantageous from an economical viewpoint.

When less than 1 part of additive per 50 parts of conventional fish feed is used, the effect of the additive is scarcely achieved.

The Dunaliella alga powder and cyclodextrin are formulated into a mixed adsorbate. Thus each particle of the Dunaliella alga powder, which is larger than the pore of the cyclodextrin, can be enclosed in said pore and therefore β -carotene can be more stably protected. Thus β -carotene can be stably maintained during storage of the fish feed or during production of the fish feed.

The Dunaliella algae used include, for example, Dunaliella bardawil and Dunaliella salina. As the cyclodextrin (simply referred to as CD) α -CD, β -CD, γ -CD, δ -CD, ϵ -CD, polymer CD and CD sugars may be used.

The fish feed additive (a) may be optionally supplemented with at least one of an antioxidant, a binder, one or more vitamin(s) and one or more drug(s).

Any non-toxic antioxidant may be used. Preferable examples of the antioxidant are vitamins C and E. The antioxidant in the mixture consisting of Dunaliella algae

powder and cyclodextrin are preferably in a weight ratio of 0.10:100 to 0.25:100.

Any non-toxic binder may be used. Preferable examples of the binder are sugars such as maltose and lactose.

5 The binder and the mixture consisting of Dunaliella algae powder and cyclodextrin are preferably in a weight ratio of 35.5:100 to 40.6:100.

Any vitamin may be added to the fish feed additive (a) in an effective amount for nutrition. However, the amount
10 of vitamins to be added is not specifically limited. Preferable examples of the vitamin are vitamin B₁, vitamin B₂, vitamin B complex and vitamin D.

Drugs may be added to a fish feed additive of the present invention in an effective amount for preventing and/or
15 treating a disease. The amount of drugs is not specifically limited. Examples of suitable drugs are antibiotics which can prevent and/or treat bacterial infections.

The fish feed additive is produced by a process comprising the steps of:

20

(a) mixing under stirring Dunaliella algae in a powder form and a cyclodextrin in a weight ratio of 100:15 to 100:50, drying and grinding to a powder or granules the mixture thereby obtained, and

25

(b) (i) either;

blending the powder or granules resulting from step (a) with a conventional powdery or granular fish feed in a weight ratio of 1:20 to 1:50,

or;

(ii) kneading in the presence of water the powder or granules resulting from step (a) with a conventional powdery or granular fish feed in a weight ratio of 1:20 to 1:50, and molding the mixture thereby obtained into pellets.

5 Optionally at least one of an antioxidant, a binder, one or more vitamin(s) and one or more drug(s) is/are mixed with the algae and cyclodextrin in step (a).

10 It has previously sometimes been observed that oily β -carotene in a Dunaliella alga powder is liberated from the algae in water and thus forms an oily film. In the case of the fish feed additive of the present invention, however, the Dunaliella alga powder is contained in the form of a mixed adsorbate with cyclodextrin and thus the liberation of β -carotene from the algae can be prevented. When the fish feed additive is blended with a common powdery fish feed and given
15 to fish as a powdery feed, therefore, β -carotene is prevented from migrating into the water and thus the fish can be efficiently fed.

20 The conventional fish feed (b) to be used in the present invention may be a powdery or granular type for fresh water fish such as carp, sweet fish and trout, and saltwater fish such as flatfish, young yellowtail, parrot fish and red sea bream.

Example

25 To 100 parts by weight of a Dunaliella bardawil alga powder, 20 parts by weight of β -cyclodextrin was added and stirred. After drying, a cyclodextrin-adsorbed fish feed additive in the form of fine granules was obtained.

30 1 Part by weight of the adsorbed fish feed additive thus obtained was blended with 30 parts by weight of a common

feed for adult carp in the form of fine granules. An appropriate amount of water was added and the mixture was kneaded to give a kneaded product.

The kneaded product was granulated with an extruder and dried. Thus an artificial carp feed containing Dunaliella algal powder in the form of pellets was obtained.

Three adult carp were fed with the artificial carp feed containing Dunaliella alga powder obtained above (test fish), while three other adult carp were fed with a common artificial carp feed (control fish). The following table shows the results of the feeding test continued for four months.

	Body length	Body weight
Control fish	1.31 ± 0.019	2.31 ± 0.051
Test fish	1.45 ± 0.079	3.10 ± 0.034

Although the body length of the test fish exceeded that of the control fish, no statistically significant difference was observed. However, the body weight of the test fish was significantly increased.



CLAIMS

1. A powdery, granular or pellet-like fish feed comprising:

(a) an additive comprising dried Dunaliella algae and a cyclodextrin in a weight ratio of 100:15 to 100:50, and

(b) a conventional fish feed, in which the weight ratio of (a) : (b) is 1:20 to 1:50.

2. A fish feed according to claim 1 wherein the additive further comprises at least one of an antioxidant, a binder, one or more vitamin(s) and one or more drug(s).

3. A fish feed according to claim 1 or claim 2 in which the antioxidant is vitamin C or E.

4. A fish feed according to any one of claims 1 to 3 in which the binder is a sugar.

5. A fish feed according to claim 4 in which the sugar is maltose.

6. A fish feed according to any one of claims 2 to 5 in which the vitamin(s) is/are selected from vitamin B₁, vitamin B₂, vitamin B complex and vitamin D.

7. A fish feed according to any one of claims 2 to 6 in which the drug is an antibiotic in an amount sufficient to prevent bacterial infections.

8. A fish feed according to claim 1 substantially as described herein.

9. A process for producing a fish feed as



claimed in claim 1 comprising the steps of:

(a) mixing under stirring Dunaliella algae in a powder form and a cyclodextrin in a weight ratio of 100:15 to 100:50, drying and grinding to a powder or
5 granules the mixture thereby obtained, and

(b) (i) either;

blending the powder or granules resulting from step (a) with a conventional powdery or granular fish feed in a weight ratio of 1:20 to 1:50,

10 or;

(ii) kneading in the presence of water the powder or granules resulting from step (a) with a conventional powdery or granular fish feed in a weight ratio of 1:20 to 1:50, and molding the mixture thereby
15 obtained into pellets.

10. A process according to claim 9 which comprises mixing at least one of an antioxidant, a binder, one or more vitamin(s) and one or more drug(s) with the algae and cyclodextrin in step (a).

20 11. A process according to claim 10 in which the antioxidant is vitamin C or E.

12. A process according to any one of claims 9 to 11 in which the binder is a sugar.

25 13. A process according to claim 12 in which the sugar is maltose.

14. A process according to any one of claims 10 to 13 in which the vitamin(s) is/are selected from



- 8 -

vitamin B₁, vitamin B₂, vitamin B complex and vitamin D.

15. A process according to any one of claims 10 to 14 in which the drug is an antibiotic in an amount sufficient to prevent bacterial infections.

5 16. A process according to claim 9 substantially as described herein.

17. Use of additive (a) as defined in claim 1 in a fish feed.
