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المجلة العراقية لبحوث السوق وحماية المستهلك

SUBSTITUTION OF ANIMAL PROTEIN BY DIFFERENT ATION OF DRIED RUMEN MEAL IN COMMON CARP *Cyprinus carpio* DIETS

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ABSTRACT

The study was conducted to show the effect of using dried rumen powder as a source of animal protein in the diets of common carp (*Cyprinus carpio* L.) on its performance, in the fish laboratory/College of Agricultural Engineering Sciences/University of Baghdad/ for a period of 70 d, 70 fingerlings were used with an average starting weight of 30±3 g, with a live mass rate of 202±2 g, randomly distributed among five treatments, two replicates for each treatment and seven fish for each replicate. Five diets of almost identical protein content and different percentages of addition of dried rumen powder were added. 25% was added to treatment T2 and 50% to treatment T3 and 75% of the treatment T4 and 100% of the treatment T5 In addition to the control treatment T1, which was devoid of dried rumen powder, the fish were fed on experimental diets of 4% of their body weight and weighed every 15 d. The results showed that the T2 treatment was one of the best experimental treatments, as it gave the highest levels for most of the studied traits. The results indicated that there were significant differences (p<0.01) and (P < 0.05) between it and the control treatment T1 in growth parameters, which included the final weight average of 715 g and the rate of increase The total weight is 512.50 g, the daily weight gain rate is 12.32 g/d, the relative growth rate is 252.47%, and the specific growth rate is 1.75 g/d. The criteria for evaluating the diet, which included the amount of feed intake 1765.26 g and the amount of protein intake 577.41 g, and the best food conversion ratio of 3.44 and the efficiency of food conversion was 29.03 % and the value of the protein produced is 64.21% and the net exploited protein is 0.73%.

Key words: Animal protein, rumen powder, diet, common carp fish.

استبدال البروتين الحيواني بنسب مختلفة من مسحوق الكرش المجفف في علائق اسماك الكارب الشائع *Cyprinus carpio*

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الخلاصة

أجريت الدراسة لبيان تأثير استعمال مسحوق الكرش المجفف كمصدر للبروتين الحيواني في علائق اسماك الكارب الشائع (*Cyprinus carpio* L.) في أدائها في مختبر الاسماك/ كلية علوم الهندسة الزراعية/ جامعة بغداد/ لمدة 70 يوما، استعمل 70 اصبعية بمعدل وزن ابتدائي 30±3 غم وبمعدل كتلة حية 202±2 غم وزعت عشوائيا على خمس معاملات بواقع مكررين لكل معاملة وسبع اسماك لكل مكرر، هيأت خمس علائق متماثلة المحتوى البروتيني تقريبا ومختلفة بنسب الاضافة من مسحوق الكرش المجفف، اذ اضيفت نسبة 25% للمعاملة T2 ونسبة 50% للمعاملة T3 و75% للمعاملة T4 و100% للمعاملة T5 فضلا عن معاملة السيطرة T1 التي خلت من مسحوق الكرش المجفف، غذيت الاسماك على العلائق التجريبية بنسبة 4% من وزن الجسم ووزنت كل 15 يوم، وأظهرت النتائج ان المعاملة T2 من افضل المعاملات التجريبية إذ اعطت اعلى مستويات لأغلب الصفات المدروسة واشارت النتائج الى وجود فروق معنوية (P<0.01) و(P<0.05) بينها وبين معاملة السيطرة T1 في معايير النمو والتي شملت معدل الوزن النهائي 715 غم ومعدل الزيادة الوزنية الكلية 512.50 غم ومعدل الزيادة الوزنية اليومية 12.32 غم/يوم ومعدل نمو نسبي 252.47% وبمعدل نمو نوعي 1.75 غم/يوم ومعايير تقييم العليقة التي شملت كمية العلف المتناول 1765.26غم وكمية البروتين المتناول 577.41غم و سجلت افضل نسبة تحويل غذائي 3.44 وكفاءة التحويل الغذائي 29.03% وقيمة البروتين المنتج 64.21% وصافي البروتين المستغل 0.73%.

الكلمات المفتاحية: بروتين حيواني، مسحوق الكرش، علائق، اسماك الكارب الشائع.

INTRODUCTION

Aquaculture represents about 47% of the total global fish production and is expected to increase to 25% in 2025 **(SOFIA, 2018)**. The expansion of population numbers and the increasing demand for fish meat due to its cheaper price compared to the meat of farm animals such as poultry and ruminants, as well as the good nutritional value of animal protein rich in essential amino acids, as well as the fat that is characterized by the essential unsaturated fatty acids, vitamins and minerals **(Fadhil *et al*., 2017)**. Because of the lack of fish production from natural resources, especially in recent decades, and the increase in the annual growth of global fish consumption by about twice the population growth, which indicates that the fish farming sector will play an important role in food security in the future **(FAO & SOFIA, 2018)**. The decrease in supply and the increase in demand for animal protein powders and the restrictions imposed on them led to an increase in their prices. Therefore, researchers and feed manufacturers turned to search for cheap, non-traditional animal or vegetable protein alternatives that are available locally to reduce production costs. The rumen is a secondary waste of ruminant animal sacrifices suitable for human consumption **(Helo, 2011**) with good nutritional value. It is a rich source of amino acids and a source of fat, vitamins and minerals beneficial to humans, which was the reason for choosing it to be a source of animal protein in the form of powder and the possibility of using it as a partial or complete substitute for Animal protein powder in the diets of common carp (*Cyprinus carpio* L.), as well as its low price in relation to animal protein that is imported in hard currency and its role in protecting the environment by using these rapidly perishable organic wastes because they contain easily digestible protein and microbial organisms related to the digestive process It is one of the causes of damage as a result of throwing these wastes, which quickly decompose due to the presence of microorganisms that result in unpleasant odors and sources of pollution to the environment.

MATERIALS AND METHODS

The experiment was conducted in the Fish laboratory/ department of animal production, college of agricultural engineering sciences, university of Baghdad. In the experiment, 10 glass basins were used, with five treatments and for each treatment, two replicates/a basin with dimensions of 30×60×40 cm, a capacity of 72 L. The walls of the basins were cleaned with water and sterilized with coarse salt. They were filled with dechlorinated water. The glass basins were provided with thermal heaters (50 watts) of the Italian Reco type. Origin: 1 per tank to maintain the water temperature between 24 and 26°C, suitable for fish growth. The experiment pools were also equipped with Chinese-origin super pump air pumps.

The rumen was purchased from the typical Kut slaughterhouse located in the south of Kut district, cleaned with water only, cut and dried under the shade at a temperature of 47°C for 10 d (Picture1), then ground and chemical analysis (Table 1) and amino acids (Table 2) in the quality control laboratory of the Department of Livestock / The Ministry of Agriculture and the laboratory of the Department of Environment and Water of the Ministry of Science and Technology.


Picture (1): The dried rumen powder used in the experiment.

Table (1): Chemical composition of dried rumen on the basis of dry weight.

Subject	Humidity (%)	Fat (%)	Protein (%)	Ash (%)	Carbohydrates (%)	Energy Kcal/k
rumen powder	4.10	16.15	45.58	8	25.57	2987

Table (2): Analysis of the amino acids of dried rumen.

Essential amino acids in the rumen	**mg/100 g**	**Non-essential amino acids in the rumen**	**mg/100 g**
Penylalanine	18.45	Aspartic acid	20.14
Leucine	17.45	Asparagine	18.65
Tryptophan	17.14	Glutamic acid	12.36
Methionine	16.52	Serine	10.52
Cysteine	14.76	Alanine	10.12
Lysine	13.26	Glycine	9.41
Valine	10.12		

The fodder materials were brought to the fish laboratory and ground with a laboratory mill Chinese type Model 100 with a capacity of 650 watts (Table 3) After calculating the proportions of the feed ingredients included in the diet, the feed materials were mixed with each other in a homogeneous form and five experimental diets were made. Dried rumen powder was added to the second diet at a ratio of 25%, the third at 50%, the fourth at 75%, and the fifth at 100% of the percentage of animal protein (Table 4). Water was added 350 ml per kilogram for each mixture of the components of the ration and placed in a Japanese meat mincer with a diameter of 4 mm. The mincing was repeated twice to ensure the consistency and pressure of the ration. Then the rations were dried by exposing them to the open air for two days and kept in numbered nylon bags according to each treatment.

Table (3): The chemical composition of the raw materials included in the composition of the experiment feed.

Feed material	Crude protein (%)	Fat (%)	Ash (%)	Fiber (%)	Soluble carbohydrates(%)
Fish powder *	55	9.3	2.8	1.2	31.7
Animal protein concentrate*	40	3.5	8.5	5.5	42.5
Soybean meal**	45	6.44	7.21	6.90	35.81
Local yellow corn**	9	4.87	2.61	2.25	80.15
Local barley**	12	3.00	13.80	9.40	63.00
Millet**	10.8	3.00	13.80	9.40	63.00
Wheat bran**	15.72	4.47	3.21	4.11	62.99

The card installed by the company*
****According to N.R.C (2011)**

Table (4): The components of laboratory rations.

Feed material	T1 (%)	T2 (%)	T3 (%)	T4 (%)	T5 (%)
Fishmeal	5	5	5	5	5
Animal protein center	25	18.75	12.5	6.25	0
Rumen powder	0	6.25	12.5	18.75	25
Soybean meal	35	35	35	35	35
Yellow corn	8	8	8	8	8
Barley	6	6	6	6	6
Millet	5	5	5	5	5
Bran	5	5	5	5	5
Flour	8	8	8	8	8
Fish fat	1	1	1	1	1
Vitamins and minera	1	1	1	1	1
Salt	1	1	1	1	1
Total	100	100	100	100	100

Common carp fingerlings (*Cyprinus carpio* L.) were brought on 26/10/2021 from the blue river company in Al Mahaweel/Babil. To the fish laboratory at the college of agricultural engineering sciences, university of Baghdad. The fish weights ranged between 25 and 33 g, and they were placed in a boiled iron tank for 24 h for their convenience. The fish were sterilized with 0.5% saline solution to get rid of external parasites, if any. The fish were randomly distributed to glass tanks with dimensions of 30×60×40 cm, which were prepared in advance. In 10 glass tanks, with an average initial weight of 30±3 g and a live mass of 202±2 g per tank, the fish were fed with five diets (5 treatments), two replicates for each treatment, and seven fish for each replicate. The feed was gradually introduced until 4% of the fish weight was reached by Three meals (8 a.m., 12 noon, 4 p.m.), the experiment lasted 70 d, starting from 10/28/2021, and the fish were weighed every 15 d with a Chinese-origin electronic sensitive scale. Growth traits and some criteria for evaluating the feed are as follows.

Total weight gain (g) (Musharraf & Khan, 2019)

$$T.W.G. = F.W. - I.W$$

Since:
(F.W) Final weight (g); (I.W) Initial weight (g).

Relative growth rate (R.G.R) (%) (Al-Ani, 2021)

$$R.G.R. = \frac{W2 - W1}{W} \times 100$$

Since:
W1= First weight (g); W2= Second weight (g).

Specific growth rate (S.G.R) (%. g/d) (Musharraf & Khan, 2019).

$$S.G.R. = \frac{\text{Ln } W2 - \text{Ln } W1}{T2 - T1} \times 100$$

Since:
Ln W2= Natural logarithm of the second weight for the period T2.
Ln W1 = The natural logarithm of the first weight for the period T1.
T2 - T1 = The amount of time between the two weights.

Daily gain rate (D.G.R) (g) (Philipose *et al*., 2013)

$$D.G.R. = \frac{W2 - W1}{T2 - T1}$$

Since:
W1 = Initial weight(g); W2 = Final weight (g); T2-T1 = Duration of the experiment (d).

Feed conversion ratio (F.C.R) (Al-Zuhairi, 2021)

$$F.C.R. = \frac{R}{G}$$

Since:
R = Feed (intake/g); G = Fish wet weight (gain/g).

Food conversion efficiency (F.C.E) (%) (Simple & Roopma, 2010)

$$F.C.E. = \frac{G}{R} \times 100$$

Since:
R = Feed (intake/g), G = Fish wet weight (gain/g).

Protein intake (P.I) (Al-Zuhairi, 2021)

$$P.I = \frac{P.Feed \times Feed\ (g)}{100} \times 100$$

Since:
Feed = Feed intake (g), P.feed = Percentage of feed protein.

Protein efficiency ratio (P.E.R) (Taha, 2021)

$$P.E.R. = \frac{T.W.G}{P.I}$$

Since:
T.W.G = Total weight gain (g).
P.I = Amount of protein ingested or provided (g).

Productive protein value (P.P.V) (Halver & Hardy, 2002).

$$P.P.V. = \frac{[(A \times W2) - (A0 \times W1)]}{[Gram\ feed \times \frac{\%CP\ of\ feed}{100}]} \times 100$$

Since:
A = Body protein at the end of the experiment (g).
A0 = Body protein at the start of the experiment (g).
W1 = Body weight at the beginning of the experiment (g).
W2 = Body weight at the end of the experiment (g).

Calculate the amount of feed intake

This experiment was conducted to determine the amount of feed provided to fish by the best percentage of the live mass weight. Fish were starved for one day and then fed gradually until saturation for 2-3 h. After an hour, the remaining feed was withdrawn at the bottom of the tank and placed in plastic cups and dried under the sun. The remaining feed was weighed and subtracted from the amount of feed provided to the fish to get the amount of feed intake.

Estimation of amino acids

The rumen amino acids were estimated in the scientific instruments laboratory/environment and water research department/Ministry of Science and Technology according to the method used by the German company Sykm for the year 2007, using a device (Clarity - Chromatography SW) of German origin.

Statistical analysis

The data were statistically analyzed using the statistical analysis system **(SAS, 2012)** according to the complete randomized design (CRD) to analyze the results, and the significant differences between the averages of the studied traits were tested using Duncan´s multiple range test at the level of significance. **(0.01)** and **(0.05)** according to the following mathematical model:

$$Yij = M + Ti + \sigma ij$$

indicate all of:
Yij = The observed value (j) of the effect of transaction (i).
M = The general average of the trait studied.
Ti = The effect of treatment on the studied trait.
σij = Random error.

RESULTS AND DISCUSSION

Water characteristics for the experiment ponds as shown in **(Table 5).**

Table (5) Water characteristics of the experiment ponds.

average temperature	Dissolved oxygen concentration rate	ammonia concentration rate	pH rate
24-26	5.0-6.5	0.02-0.05	7.1-8.1

It is clear from **(Table 6)** the chemical analysis of the experimental diets used in feeding the common carp fish (*Cyprinus carpio* L.).

Table (6): Chemical analysis of experiment diets containing different proportions of rumen powder.

Transactions	Humidity (%)	Fat (%)	Protein (%)	Fiber (%)	Ash (%)	Carbohydrates (%)	Energy Kcal/Kg	Protein to energy ratioKcal/Kg
T1	2.40	2.55	32.63	7	11.5	43.92	3981	81.69
T2	2.25	3.4	32.71	6.9	11	43.74	3767	86.38
T3	2.40	4	33.06	6.3	9.5	44.74	3924	84.25
T4	2.80	4.55	32.88	6.1	10	43.67	3983	83.00
T5	2.85	6.06	32.18	6.5	8.5	43.91	3995	80.55

T1 control diet without adding; **T2** dried rumen powder 25%; **T3** dried rumen powder 50**%**; **T4** dried rumen powder 75**%; T5** dried rumen powder 100%.

The results of the chemical analysis of the amino acids in the rumen showed an increase in the levels of essential amino acids, as the amino acid phenylalanine recorded the highest percentage of 18.4 mg / 100 g, followed by leucine acid with 17.4 mg / 100g, then tryptophan acid at a rate of 17.1 mg / 100 g, followed by methionine acid 16.5 mg / 100 g, followed by Cysteine With a percentage of 14.7 mg / 100 g, followed by acid Lysine at a rate of 13.2 mg / 100 g, and the lowest percentage of the amino acid valine was 10.1 mg / 100 g **(Table 7)**.

Table (7): amino acids content in laboratory dried rumen protein and amino acids in animal protein concentrate.

Essential amino acids in the rumen *	mg/100 g	Non-essential amino acids in the rumen *	mg/100 g	Essential amino acids in the animal center **	mg/100 g
Penylalanine	18.45	Aspartic acid	20.14	Lysine	5.0
Leucine	17.45	Asparagine	18.65	Methionine	4.0
Tryptophan	17.14	Glutamic acid	12.36	Methionine+ Cysteine	4.7
Methionine	16.52	Serine	10.52	Tryptophan	0.42
Cysteine	14.76	Alanine	10.12	Threonine	1.6
Lysine	13.26	Glycine	9.41		
Valine	10.12				

*Laboratory analysis; ** The card installed by the company.

Growth criteria

Statistical analysis was carried out for the growth parameters of common carp fish as shown in **(Table 8)**, in which the initial biomass weight for all treatments was uniform at a rate of 202±3 g. The results of the statistical analysis showed that most of the treatments were significantly superior to the control treatment in final weight, weight gain and average Relative growth and specific growth rate, as each of T2, T3, and T4 outperformed the control treatment T1 in the above-mentioned characteristics, while there were no significant differences between the latter and T5. As for the characteristic of the daily weight gain rate, treatment T2 outperformed the control treatment T1, which did not Significantly different with treatments T3 and T4, while there was no significant difference between control treatment T1 and treatment T5. At the level of significance (P<0.01) and (P<0.05).

Table (8): Some growth parameters of common carp fish fed on diets containing different percentages of dried rumen powder (mean ± standard error).

Transactions	starting weight g/live mass	final weight g/live mass	T.W.G g	D.G.R g	R.G.R (%)	S.G.R (%) g/d
T1	1.00± 202 a	14.50± 455.5 c	15.50± 253.50 c	0.714± 5.2857 b	8.295± 125.535 c	0.075± 1.135 c
T2	1.00± 203 a	0.50± 715 a	0.50± 512.50 a	2.321± 12.321 a	1.490± 252.470 a	0.115± 1.755 a
T3	1.00± 202 a	46.50± 616.5 ab	45.50± 414.50 ab	0.821± 8.607 ab	21.510± 250.090 ab	0.120± 1.600 ab
T4	1.00 ±202 a	25.00± 615 ab	24.00± 413 ab	0.857± 8.142 ab	10.325± 204.400 ab	0.040± 1.620 a
T5	1.00± 200 a	46.00± 498 bc	45.50± 297.50 bc	1.857± 6.285 b	22.325± 148.325 bc	0.085± 1.275 bc
morale level	N.S	**	**	*	**	*

N.S. There are no significant differences; ***** There are significant differences at the level of probability < 0.05; ****** There are significant differences at the level of probability 1..0.0>P.

It appears from the presentation of the results of the current study that the laboratory rations manufactured using dried rumen powder as a substitute for animal protein increased the values of total weight gain and daily increase, and this was reflected on the specific growth rate and relative growth rate compared to the control diet (T1), as the treatment T2 showed a highly significant superiority (P<0.01) The best results were recorded compared to the rest of the treatments, and the reason may be due to the nutritional efficiency of the ration and its palatability by the fish by increasing the amount of feed intake **(Table 9)** or because the dried rumen powder is a good source of protein, which in turn reflected on the increase in growth rates or the balance of the necessary essential amino acids for growth **(Table 7)** **(Tegene *et al.*, 2018)** indicated that it is necessary for protein in fish diets to contain essential amino acids in order to be an integrated protein.

Feed evaluation criteria

The results of the statistical analysis showed a significant superiority (P<0.01) in most of the experimental treatments over the control treatment for the quantity of feed intake **(Table 9)**, as each of the treatments T2, T3, and T4 outperformed the control treatment T1, while there were no significant differences between the latter. and T5. The amount of feed consumed for the treatment T2 was (1765.26 g), followed by treatments T3 and T4, which recorded 1667.12

and 1663.20 g, respectively, and treatments T5 and T1 recorded 1452.22 and 14142.32 g, respectively. Most of the experiment's treatments outperformed the control treatment for the amount of protein intake **(Table, 9)**, as treatment T2 recorded the highest amount of protein intake, which amounted to 577.415 g, followed by treatments T3 and T4, which recorded 551.15 and 546.86 g, which outperformed the control treatment T1, which recorded the lowest amount of protein intake. It reached 460.84 g, which did not differ significantly with treatment T5, which amounted to 467.23 g.

The results of the statistical analysis showed that there were significant differences ($P < 0.05$) between the experimental and control treatment T1 in terms of the food conversion ratio **(Table 9)**. The treatment T2 recorded the best food conversion ratio, which amounted to 3.445, followed by the two treatments T3 and T4, which recorded 4.050 and 4.035, which did not Significantly differed with treatment T2, followed by treatment T5, which scored 4.980, which did not differ significantly with them, and the control treatment recorded the worst food conversion ratio, which amounted to 5.585, which did not differ significantly with treatment T5.

As for the feed conversion efficiency **(Table 9)**, treatment T2 outperformed the control treatment and the rest of the treatments, which scored 29.03%, followed by treatments T3, T4 and T5 with rates of 24.85, 24.82 and 20.83%, respectively, and the control treatment T1 recorded the lowest percentage, which amounted to 17.94%.

It is noted from the foregoing that the moral superiority of the quantity of feed intake, which was reflected in the amount of protein consumed, the best food conversion ratio (which is an important indicator in assessing the quality of feeds) and the highest food conversion efficiency of the T2 treatment, may be attributed to fish palatability for the ration, perhaps due to the smell of rumen powder or integrated in Its content of essential amino acids due to the presence of 25% of rumen powder, as **He *et al*. (2013)** indicated that the availability and balance of essential amino acids in fish diets plays a major role in fish growth **(Table 7)**. **(Signor *et al*., 2017)** indicated that the presence of appropriate amounts of amino acids in the feed increases fish production, especially since fish cannot build protein in its body except through amino acids, which are the basic units in building protein in the body.

The results showed in the quality of the protein efficiency ratio **(Table 9)** that there were no significant differences between the experimental treatments on the one hand and with the control treatment on the other hand, as T2 recorded the highest values of 0.70, followed by T3 (0.52), T4 (0.49), (0.47) and T1 (0.42) The use of dried rumen powder at 25% in the T2 ration had a good effect on growth performance, and its effect was clear in increasing the amount of feed consumed, which led to a high rate of weight gain or due to the proportion of protein to energy level in the ration, as **Li *et al*. (2013)** indicated. The protein efficiency ratio is negatively affected when the protein-energy ratio is abnormal. This is reflected in the quality of the protein produced for treatment T2 and its superiority over the control treatment and other experimental treatments, which amounted to 64.21%, followed by treatments T3, T4 and no significant differences were recorded between them, as they recorded 50.59 and 49.19%, followed by treatments T5 and the control treatment T1, both of which did not record significant differences as they recorded 36.42, 31.92%. The diet of fish should contain all the amino acids necessary for protein synthesis **(Diemer *et al*., 2014),** which was reflected on the growth and weight gain of the fish of this treatment.

Table (9): Criteria for evaluating the diet for common carp fish fed on diets containing different percentages of dried rumen powder (mean±standard error).

Transactions	F.I (g)	P.I (g)	F.C.R	F.C.E (%)	P.E.R	P.P.V (%)
T1	22.68±1412.32 b	7.40±460.84 b	0.25±5.58 a	0.00±17.94 e	0.005±0.42 a	1.31±31.92 c
T2	63.70±1765.26 a	20.83±577.41 a	0.12±3.44 c	0.01±29.03 a	0.175±0.70 a	1.77±64.21 a
T3	68.32±1667.12 a	22.59±551.15 a	0.28±4.05 bc	0.01±24.85 b	0.015±0.52 a	3.34±50.59 b
T4	41.72±1663.20 a	13.72±546.86 a	0.13±4.03 bc	0.02±24.82 c	0.040±0.49 a	0.46±49.19 b
T5	32.62±1452.22 b	10.49±467.32 b	0.65±4.98 ab	0.03±20.83 d	0.120±0.47 a	3.45±36.42 c
morale level	**	**	*	**	N.S	**

N.S. There are no significant differences; ***** There are significant differences at the level of probability < 0.05; ****** There are significant differences at the level of probability 1..0.0>P.

CONCLUSION

The possibility of using dried rumen powder as an animal protein source in common carp fish diets, with percentages of 25, 50 and 75% in common carp fish diets, and 25% is the best compared to the control diet. It is also possible to use dried rumen powder at 100%, but it did not reach the levels achieved by the percentage 25% through this can produce a local protein center from the remnants of animal slaughterhouses and encourage the use of locally available feed instead of imported feed, which contributes to reducing the cost of production and reducing the import percentage and encouraging small business owners in the animal feed industry in general and fish in particular.

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