Effect of feeding Dried Distiller Grains with Solubles (DDGS) on fillet color of Vietnamese Catfish (Tra)

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Use of Dried Distiller Grains with Solubles (DDGS) for feeding Common Carp under Vietnam commercial condition

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Use of Dried Distiller Grains with Solubles (DDGS) for feeding Red Tilapia under Vietnam condition

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Executive Summary

Feeding trial on catfish (Tra) has been conducted in Vinh Hoan Feedmill Co., Vietnam to measure the fillet color with an inclusion of Dried Distiller Grain Solubles in the feed. Dried distillers Grains with Solubles is co product of ethanol industry made from US corn. DDGS is considered potential ingredient for feeding fish due to economic and nutritional value. A feeding trial of DDGS has been conducted to Vietnam catfish (Tra) raised in polyethylene tank. DDGS was included at 15% in an iso protein and caloric diet in floating form. The dietary treatments were fed to 150 fish at size around 60g for 3 months and replicated 6 times. DDGS diet was readily consumed by catfish and there is no significant effect to growth and mortality of the fish, although numerically there was a slight improvement on growth rate and less mortality when catfish fed DDGS. Feeding DDGS at 15% improved feed conversion ration from 3.01 in control diet to 1.95 in the DDGS diet. Result of measurement of fish fillet color using Hunter system indicated that there is no difference on L and b value of the fillet between the dietary treatments. It is concluded that feeding DDGS at 15% to Vietnamese catfish did not affect color of fillet.

Introduction

Catfish Tra is one of major fish grown in Vietnam and is considered popular species for human consumption. It is grown in a pond water or cage system in reservoir. Catfish Tra is cultured until market size in the range of 1000g. Catfish Tra feed is made of several ingredients such as soybean meal, wheat by products, fish meal, rice by product etc. Dried Distillers Grains and Soluble is by product of ethanol production made of corn and produced in a significant amount in US and other countries. It has been shown to be economically feasible for animal feed especially dairy cattle, swine and poultry. It is not much information available for feeding fish despite high protein content (28%) and relatively cheaper cost of feed ingredients. With increasing of DDGS production in USA, the availability of DDGS for export to SEA will increase.

Previous studies on feeding newly DDGS to fish were conducted to tilapia (Tidwell, et al. 2000) or trout (Cheng and Hardy, 2004) with little information on catfish. One of the attractive features of using DDGS in catfish diets is that it does not contain anti-nutritional factors found in other protein sources such as soybean meal (trypsin inhibitors - Wilson and Poe, 1985; Shiau et al., 1987) or cottonseed meal (gossypol - Jauncey and Ross, 1982; Robinson, 1991). Tidwell et al. (1990) conducted an experiment over an 11-week period where channel catfish fingerlings were fed diets containing 0, 10, 20 and 40% distiller's grains with solubles, replacing some of the corn and soybean meal. After the 11-week feeding period, there were no significant differences in individual fish weight, percentage survival, feed conversion or protein efficiency ratio among dietary treatments.

In a study conducted by Webster et al. (1993), cage reared juvenile catfish were fed diets containing 0, 10, 20 or 30% DDGS to partially replace corn and soybean meal in the diet. There were no differences in individual fish weights, survival, feed conversion, carcass composition, carcass waste (head, skin, viscera) and organoleptic properties of the filets among dietary treatments. Results from this study suggest that up to 30% DDGS can be added to channel catfish diets with no negative effects on growth performance, carcass composition or flavor qualities of the filets. Therefore, DDGS is considered an acceptable ingredient in diets for channel catfish (Tidwell et al., 1990; Webster et al., 1991).

In order to promote the DDGS for feeding catfish, technical information on feeding value of DDGS produced in USA should be available to consumers. It is expected that such type of information can be generated locally under SEA condition.

DDGS has been introduced to many fish companies in Vietnam that produce feed for own use and DDGS has been considered a newly potential ingredient for catfish feed, considering the nutritive value and relative cost to other existing ingredients. However several catfish companies put a concern that feeding DDGS to catfish may result to discolorization of catfish meat as xanthophylls from DDGS might be transferred to the catfish meat. Very little information is currently available on the effect of feeding DDGS to fish and its effect to meat quality. Purpose of this trial was to evaluate of DDGS for feeding Vietnam catfish on the growth performance and its effect to meat color.

Materials and Method

Feeding trial will be carried out at farm in Vin Hoang Farm, Dong Thap, Vietnam. Feeding trial comprises 2 dietary treatments comprise:

- TF-1. Control diet without DDGS
- TF-2. Diet contains 15 % DDGS

Chemical composition of US DDGS made of corn is presented in Table 1, while feed formula and calculated nutrient composition of the diets containing DDGS and control without DDGS is presented in table 2.

A feedmill in Ho Chi Minh will manufacture the dietary treatment according to formula specification given by Technical Director of USGC in floating form. The size of pellet would be 3-4mm. Each dietary treatment will be fed to Catfish Tra fish at size 50g. The fish will be grown in plastic tank at size 3-5m3 (effective volume for water 2 m3) containing 150 fish per cage and placed in pond as recommended. Each treatment will be replicated 6 times and the trial will be performed for 3 months to reach marketable size which approximately 300g.

Table 1 Chemical composition of US DDGS used in the trial

Nutrient	Composition (% dry matter)
Protein	30.2
Fat	10.9
Crude Fiber	8.8
Ash	5.8
Nitrogen Free Extract	45.5
Acid Detergent Fiber	16.2
Neutral Detergent Fiber	42.1
Lysine	0.85
Methionine	0.55
Calcium	0.06
Phosphorus	0.89

Table 2 Feed formula, calculated composition and price of diets used in the feeding trial

Nutrient	DDGS 0%	DDGS 15%	Price VnD/kg
Fish oil	0.2	0.2	13000
Fish meal 50%	5.92	0.654	10000
Fish meal 60%	5.00	5.00	16520
Soybean meal dehulled	13.0	13.0	8922
Soybean meal India	12.00	12.00	8922
Cassava meal	15.00	20.00	3574
Rice bran I 12.5	19.11	14.65	4500
Rice polish 11	15.00	15.00	4500
Rapeseed meal	4	4	5620
Wheat bran	10	10	4476
DDGS 27	0.00	15.00	6000
DL Methionine	0.157	0.176	115455
Vitamin + Mineral Mix Nutriway	0.50	0.50	41200
Biomoss	0.10	0.10	64400
Ronozyme P (L)	0.015	0.015	147600
Calculated Composition			
Digest. Energy for fish (Kcal/kg)	3186	3168	
Crude Protein (%)	26.0	26.0	
Fat (%)	7.7	7.8	
Crude fiber (%)	4.1	4.4	
Calcium (%)	1.5	1.5	
Phosphorus Avail. (%)	0.45	0.65	
Lysine	1.60	1.51	
Cystine	0.33	0.34	
Methionine	0.51	0.53	
Threonine	1.00	1.00	
Vitamin C	30	30	
Cost (VnD/kg)	**6891**	**6851**	

Feeding system

At least 2500 fingerling of Catfish Tra at size 50g (12 cages x 150 fish=1800 plus mortality) will be purchased from supplier and will be adapted in the cages before the trial is started. Initially feed will be offered at 5% biomass and fed 4 times per day at 7:30am, 10:30am, 13:30pm and 15:00pm. Amount of feed given will be based on 95% satiation. Initial of feed will be given at amount that can be consumed by fish within 10 minutes multiplied by 90% and will be given in that amount for 5 days. The following 5 days will be given at full amount therefore the average would be 95% satiation. This calculation will be repeated again for every 5 days period. All cages will be covered by shaded cloth to prevent an escape.

Measurement

Fish will be sampled by mid of trial while total weighing will be performed when they reach size at approximately 300g. The daily mortality and feed consumption will be recorded. At end of trial, individual fish will be separated based on the size to measure the variability. Samples of fish will be taken for carcass evaluation by measuring the color. Feed conversion ratio will be calculated and corrected for the mortality weight. Cost of feed per kg body weight gain will be calculated. Samples of feed (250g) will be collected and analyzed in laboratory.

Statistical Analyses

Randomized Completely Design with 2 treatments and 6 replicates containing 150 fishes per replicate cage will be used in this trial for each species of fish. Data was analyzed using computer program SAS version 6.12. Any significant different due to the treatment will be further analyzed using Duncan.

Results and Discussion

Performance of Vietnam catfish (Tra) fed Dried Distillers Grains with Solubles (DDGS) at 15% inclusion in diet compare to control diet without DDGS is presented in Table 3.

Result indicated that feeding DDGS 15% in the diet did not affect significantly growth performance. Catfish fed DDGS reached body weight at 103.3g while control catfish only 94.8g despite initial weight is slightly less in catfish fed DDGS (59.7g). However, feeding DDGS to Vietnam catfish significantly improved feed conversion ratio, feed/gain of catfish fed DDGS is 1.95 compare to control fish at 3.01. Mortality of fish fed DDGS at 15% also lower compare to the control diet but it was not statistically different. The lower mortality was also reported when tilapia was fed DDGS in another feeding trial conducted in Vietnam (Tangendjaja et al. 2007).

Picture of fish fillet collected from each replicated tank is presented in Figure 1 and 2.

Figure 1 and 2 show the 6 replicates of filet of catfish fed DDGS (D1-6) and fed control diet (N1-6) and it was clearly found that color of fillet is not different between catfish fed DDGS or not.

Result on color measurement of fish fillet after feeding DDGS at 15% for 3 months is presented in Table 4. The color measurement was performed using Toshiba color difference meter and expressed on L, a and b as Hunter Lab system. It was reported that L (measure of lightness) and b (measure of yellowness) value is more important to measure possible yellow color derived from DDGS.

Table 3 Performance of catfish fed 15% DDGS

Treatment	No. fish at start	No. fish at end	Av. initial weight (g/fish)	Av. weight at end (g/fish)	Feed/gain
Control	150	138.8	64.2	94.8	3.01[a]
DDGS 15%	150	142.7	59.7	103.3	1.95[b]
SEM		1.9	5.4	9.5	0.33

SEM : Standard Error Means, Av. = Average of 6 replicated tanks; superscript with different letter indicates significant different (P<0.05)

Table 4 Color measurement of fillet of catfish fed DDGS as expressed by Hunter system in 4 different positions

	Position 1			Position 2			Position 3			Position 4		
Treatment	**L1**	**a1**	**b1**	**L2**	**a2**	**b2**	**L3**	**a3**	**b3**	**L4**	**a4**	**b4**
Control	45.79	3.01[a]	3.87	45.68	2.35	3.99	46.31	2.27	4.04	45.42	2.36	4.73
DDGS 15%	43.66	1.21[b]	2.28	44.19	2.38	2.95	43.31	1.61	3.74	44.17	2.37	3.71
SEM	0.89	0.5	0.53	0.92	0.51	0.71	0.99	0.73	0.68	1.04	0.84	0.58

SEM : Standard Error Means; superscript with different letter indicates significant different (P<0.05)

Figure 1 Fillet of Vietnamese catfish fed DDGS at 15% in the diet for 3 months

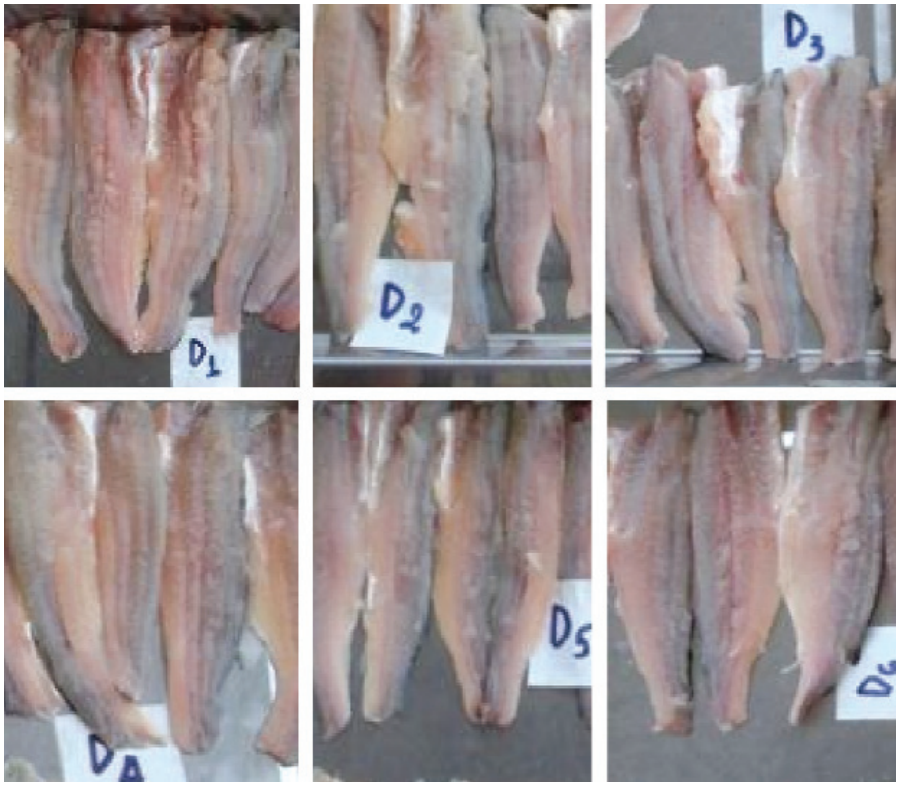

Figure 2 Fillet of Vietnamese catfish fed control diet without DDGS for 3 months

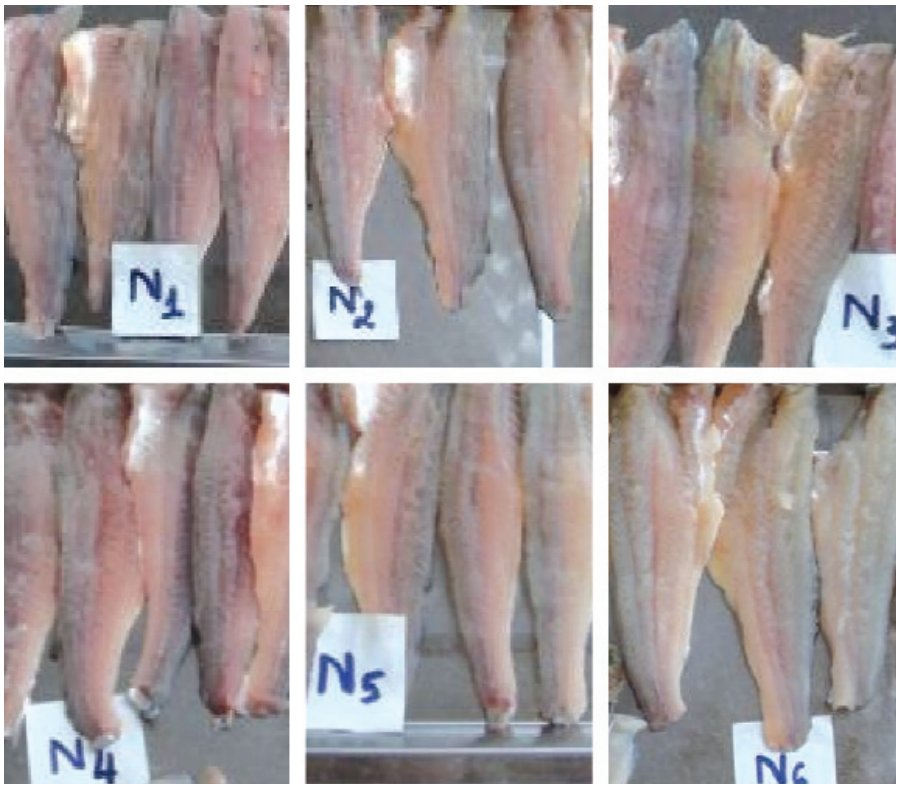

Table 4 indicated that there is no different on color of fillet of Vietnam catfish fed 15% DDGS. The average L and b value for fillet of catfish fed DDGD is 43.8 and 3.18 respectively while for fillet of catfish fed control diet without DDGS is 45.8 and 3.99 respectively. Yellow color of DDGS have L and b value >50 and 4 (Cromwell et al, 1993). This result support the observation of fillet color that feeding DDGS at 15% level in the diet did not affect the color of fillet

Cost of formula of the diet containing 15% DDGS can be seen in Table 2. Based on the ingredient price existing in Vietnam at beginning of the trial (October 2009) showed that inclusion of DDGS at 15% level in catfish diet would reduce cost of formula at VND 40/kg from VND 6891/kg of feed without DDGS to VND 6851/kg of feed with 15% inclusion of DDGS. However, it should be bear in mind that the saving would be fluctuated as ingredients price changed.

Conclusion

Feeding DDGS at 15% in the diet did not affect the fillet color of Vietnam catfish (Tra). There is an indication that feeding DDGS would improve feed utilization by catfish. Based on the ingredient price in Vietnam, inclusion of DDGS in the diet would decrease cost of feed formula.

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Abstract

Feeding trial on common carp has been conducted in Hoa Binh reservoir, Hanoi, Vietnam to measure the optimum inclusion of Dried Distiller Grain Solubles in the feed. The trial was performed using common carp fish with initial weight 26-51g raised for more than 3 months up to around 200 g in floating cages placed in a reservoir. Four dietary treatments containing DDGS at 0, 5, 10 and 15% were formulated in similar dietary energy (2.9 Mcal/kg) and protein level (29%) of feed, composed mainly with soybean meal, wheat by products, rice bran, fish meal, meat and bone meal and fish oil. Results of feeding for 3 months showed that increasing level of DDGS in the diet did not affect growth rate and feed consumption of the fish. There was an indication that fish fed 10 and 15% DDGS grew in faster rate (40 g/month) than that fish fed lower level (0 and 5%) of DDGS (28 g/month). Fish survivability was around 99.3-99.5 and there was no different due to the dietary treatment. Fish meat evaluation at end of trial indicated no different in moisture, protein and fat content and meat color was similar among the dietary treatment. In conclusion the DDGS can be included in common carp diet up to 15% and did not affect the growth performance and meat quality.

Introduction

Aquaculture is one of the fastest growing food producing industries in the world. Fish meal has traditionally been used in commercial fish feed as a major source of dietary protein for many years. However, when global fish meal production declines and fish meal prices increase, fish nutritionists begin considering less expensive plant protein sources. Plant protein sources have traditionally been considered to be inferior to fish meal in fish diets. However, when two or more complimentary plant protein sources, such as distiller's dried grains with solubles (DDGS) and soybean meal, are added to the diet, the potential exists to replace all of the fish meal in the diet.

Limited data was available on feeding value of DDGS for fish feed. DDGS has been fed successfully to catfish; Tidwell et al. (1990) conducted an experiment over an 11-week period where channel catfish fingerlings were fed diets containing 0, 10, 20 and 40% distillers grains with solubles, replacing some of the corn and soybean meal. After the 11-week feeding period, there were no significant differences in individual fish weight, percentage survival, feed conversion or protein efficiency ratio among dietary treatments. In 1993, Webster et al. conducted feeding study to juvenile catfish and suggested that up to 30% DDGS can be added to channel catfish diets with no negative effects on growth performance, carcass composition or flavor qualities of the filets. Therefore, DDGS is considered an acceptable ingredient in diets for channel catfish (Tidwell et al., 1990; Webster et al., 1991).

Wu et al. (1994) reported that diets containing either corn gluten meal (18%) or DDGS (29%) and 32% or 36% crude protein, resulted in higher weight gains for tilapia than fish fed a commercial fish feed containing 36% crude protein and fish meal for tilapia with initial weight of 30 g. In a subsequent study, Wu et al., (1996) evaluated the growth responses over an eight week feeding period of smaller tilapia (0.4 g initial weight and concluded that feeding diets containing 32%, 36% and 40% protein and 16-49% protein-rich ethanol co-products will result in good weight gain, feed conversion and protein efficiency ratio for tilapia fry.

Common Carp is one of major fish grown in Asia and is considered popular species for human consumption. It is grown in a pond water or cage system in reservoir. Common carp is cultured until market size in the range of 500- 800g. Common Carp feed is commonly made of several ingredients such as soybean meal, wheat by products, fish meal, rice by product etc. Dried Distillers Grains and Soluble is by product of ethanol production made of corn and produced in a significant amount in US and other countries. It has been shown to be economically feasible for animal feed especially in dairy cattle, swine and poultry. However, information on the use of DDGS for feeding fish is limited, despite a high protein content (27%) and relatively cheaper cost of feed ingredients. With increasing of DDGS production in USA, the availability of DDGS for export to SEA will increase. Information on feeding value of DDGS for common carp would be useful for fish farmers in the region. It is expected that such type of information can be generated locally under South East Asia condition.

Materials and Method

Feeding trial was carried out at Hoa Binh Reservoir, Cong Ty Tinh Thuong Mai, Hoa Binh Province, Vietnam from September to November, 2007. Feeding trial comprises 4 dietary treatments comprise:

- DDGS 0%. Control diet without DDGS contains only vegetable protein
- DDGS 5%. Diet contains 5% DDGS
- DDGS 10%. Diet contains 10% DDGS
- DDGS 15%. Diet contains 15% DDGS

Feed for trial was manufactured at Quang Viet Feedmill and Trading Co. Ltd., Km 64 + 500, Highway 5A, Kim Thanh District, Hai Duong, Vietnam using locally available ingredients either produced locally or imported. Dietary formula containing 0,5,10 and 15% of DDGS is presented in Table 1.

The dietary formulas contained similar Digestible Energy and Crude Protein value include amino acids. The feed was processed using wet extruder to produce complete feed in floating form. The size of pellet was 3-4mm. Each dietary treatment was fed to Common Carp fish at size 26-51g. The fish was grown in floating cage made of nylon net (mesh 1) at size 2x2x2m (effective volume for water 6 m3) containing 1200 fish per cage. Each treatment was replicated 5 times and the trial was performed for 3 months to reach marketable size which approximately 200g.

Feeding system

At least 12000 fingerling of Common Carp at size 10g (20 cages x 600 fish=12000) was purchased from supplier and was adapted in the cages before the trial is started. Initially feed was offered at 5% biomass and fed 4 times per day at 7:30am, 10:30am, 13:30pm and 15:30pm. Amount of feed given was based on 95% satiation. Initial of feed was given at amount that can be consumed by fish within 10 minutes multiplied by 90% and was given in that amount for 5 days. The following 5 days was given at full amount therefore the average would be 95% satiation. This calculation was repeated again for every 10 days period. All feed was placed in special feeding boxes and cages were covered by nylon net to prevent an escape.

Table 1 Dietary composition and calculated nutrient of Common Carp feed containing different level of DDGS

Ingredient	DDGS 0%	DDGS 5%	DDGS 10%	DDGS 15%
SBM (%)	44.50	46.42	41.71	40.12
Cassava (%)	20.00	20.00	20.00	20.00
Rice bran (%)	15.00	15.00	13.40	10.00
Fish meal (%)	5.00	5.00	5.00	5.00
Meat & bone meal (%)	5.00	2.12	5.00	5.00
Wheat pollard (%)	4.60	1.10	-	-
DDGS (%)	-	5.00	10.0	15.00
Fish oil (%)	2.90	2.89	2.89	2.88
Corn Gluten meal (%)	1.00	-	-	-
MCP (%)	1.00	1.47	1.00	1.00
Vit. and Min. mix for Fish (%)	0.50	0.50	0.50	0.50
Lecithin (%)	0.50	0.50	0.50	0.50
Total	100.000	100.000	100.000	100.000
Calculated Nutrient				
Digest. Energy (Mcal/kg)	2.90	2.87	2.90	2.92
Protein (%)	29.1	28.7	29.0	29.1
Fat (%)	8.0	8.0	8.4	8.3
Crude fiber (%)	4.9	5.0	4.9	4.9
Ash (%)	8.1	8.0	8.2	8.0
Phosphorus, Total (%)	1.18	1.17	1.17	1.15
Lysine (%)	1.67	1.67	1.64	1.62
Methionine (%)	0.43	0.43	0.44	0.45
Met. + Cyst. (%)	0.87	0.87	0.89	0.92
3 fatty acids (%)	1.0	1.0	1.0	1.0
6 fatty acids (%)	0.7	0.9	1.1	1.2

Measurement

Fish was sampled and weighed every 2 weeks while total weighing was performed every month and then at final when they reach at approximately 200g. The daily mortality and feed consumption was recorded. At end of trial, three common carp from each treatment were randomly selected for analyzing the nutritional value in the Common Carp meat by measuring the protein, fat and moisture content of fish. Samples of feed (250g) was collected and analyzed in laboratory for protein, fat and ash.

Statistical Analyses

Randomized Completely Design with 4 treatments and 5 replicates containing 330 fishes per replicate cage was used in this trial for each species of fish. Data was analyzed using computer program (SAS ver. 6.12) and any significant different due to the treatment was further analyzed using Duncan.

Results and Discussion

Body weight change in Common Carp during feeding different level of DDGS for 3 month period is presented in Figure 1. Body weight increased as fish grow as expected, from around 25-50g to around 200g in 3 months. Feed containing DDGS was readily consumed by Common Carp which may indicate that there was no palatability problem associated with DDGS in feed.

Based on change of fish body weight, there is no clear difference between the treatments due to high variability among the body weight. Further regression analyses were used to compare the growth rate due to the treatments. The result in Figure 1 indicated that coefficient of regression for treatment DDGS 10% and 15% were 40.7 and 40.0 respectively while regression coefficient for DDGS 5% and 0% were 29.7 and 28.1. This result showed clearly that feeding DDGS at 10 and 15% gave a higher growth rate compare to that fed 0 or 5%.

Body weight changes and survivability of common carp after feeding Dried Distillers Grains and Solubles at different level is presented in Table 2.

Figure 1 Growth rate of Common Carp fed different level of DDGS for 3 month

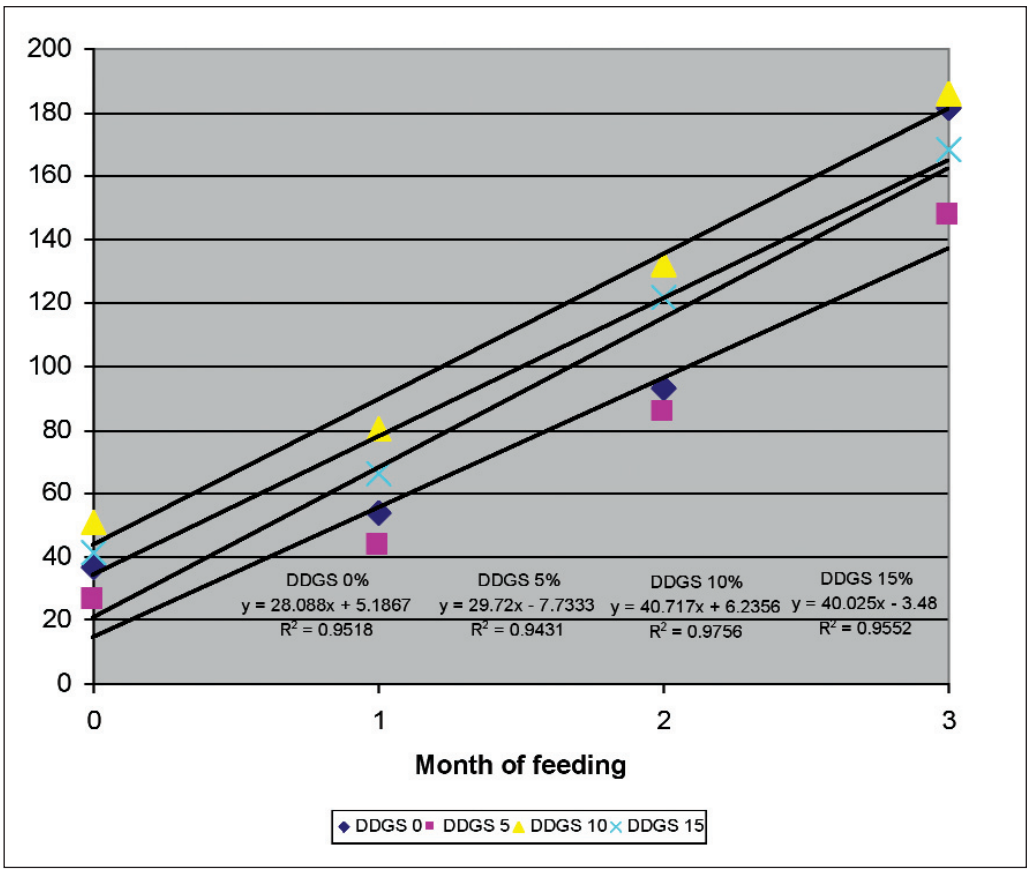


Table 2 Performance of Common Carp fed different of DDGS after 4 month culture period (mean values)

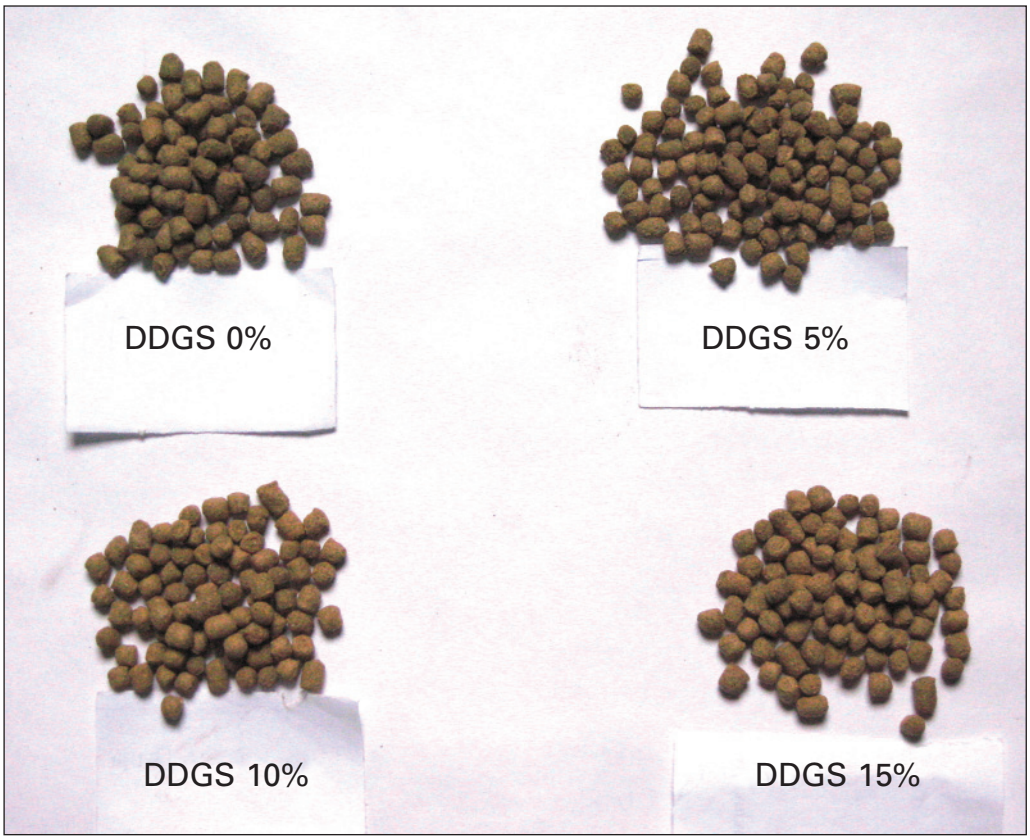
Descriptions	DDGS 0%	DDGS 5%	DDGS 10%	DDGS 15%	SEM
No. of fish/cage	1200	1200	1200	1200	
Ave initial weight (g)	36.9	26.2	50.7	41.6	4.9
Weight at 2 months (g)	54.0	43.3	80.2	66.6	6.6
Weight at 3 month (g)	93.1	85.6	132.1	121.6	10.0
Weight at 4 month (g)	181.5	147.8	186.0	168.6	11.9
Number Fish died/cage	8.2	6.6	7.4	8.2	
Survival rate (%)	99.3	99.5	99.4	99.3	0.1

SEM : Standard Error Means

Survival rate is not statistically different among the treatment, the value ranges from 99.3-99.5% and it was considered very high. There was no disease challenge during the fish culture although the fish growth was considered slow for common carp. Previous study of feeding DDGS to tilapia in Vietnam indicated an improvement on survival rate when DDGS was included in the diet (Tangendjaja and Chien, 2007).

Proximate composition of feed during the trial period is presented in Table 3. The expected composition of the feed is in closed agreement with calculated analyses presented in Table 1, except fat content was considered much lower than expected and protein was only 26% while calculated analyses was 29%. Lower result in fat content of the feed was related with the method of analyses of fat that was measured by ether extract. It was suggested that for extruded feed, the fat content should be analyzed using acid hydrolyses method prior to extraction. Result of analyses indicated a higher ash level but lower protein level in the feed compared to table 1 and it might be related with the use of meat and bone meal and/or fish meal in the diet.

Figure 2 Pellet color of fish feed containing different level of DDGS



Picture of extruded feed containing different level of DDGS is presented in Figure 2. Increasing level of yellow DDGS in the diet affected the color of pellet. The pellet color was lighter as the level of DDGS increased and it was related with the yellow color of DDGS derived from yellow corn. The color of DDGS can be varied depending upon the raw materials used in ethanol production and DDGS derived from wheat is normally darker color than that derived from yellow corn.

Features: 0% DDGS: Dark brown; 5%DDGS:Brown; 10%DDGS: light brown; 15% DDGS pale yellow

Chemical composition of the fishes fed different level of DDGS is presented in Table 4 while color of fish meat is shown in Figure 3.

Composition of Common Carp after feeding DDGS at different levels is presented in Table 4.

Table 3 Proximate composition of feed containing different level DDGS

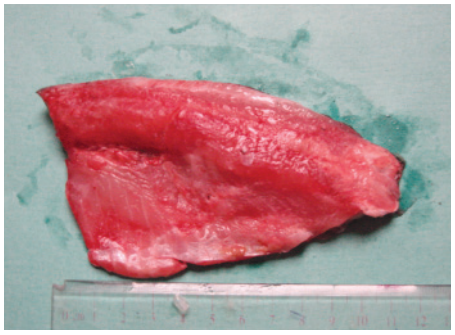
Feed	Protein %	Fiber %	Ash %
DDGS 0%	25.00	1.58	11.11
DDGS 5%	25.23	1.51	10.39
DDGS 10%	25.73	1.25	10.28
DDGS 15%	25.97	1.73	10.86

Table 4 Nutritional composition of Common Carp meat fed different level of DDGS

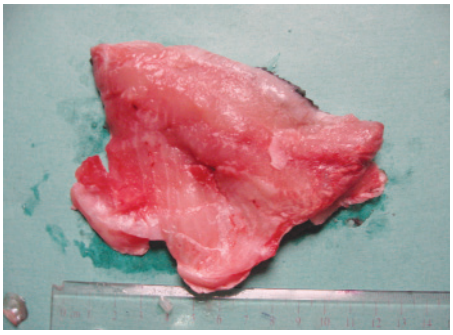
Treatments	Moisture (%)	Protein (%)	Fat (%)
DDGS 0%	68.8	16.3	14.5
DDGS 5%	68.1	16.4	13.9
DDGS 10%	68.1	16.4	13.8
DDGS 15%	68.6	16.6	13.2
SEM	0.8	0.4	0.5

SEM : Standard Error Means

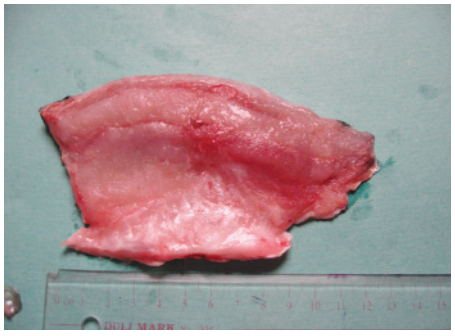
Figure 3 Picture of Common Carp flesh after feeding DDGS at different level for 3 months



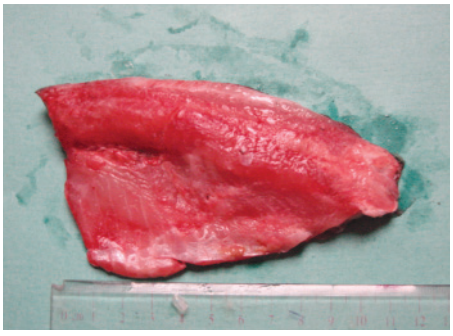
Formula 1 (0% DDGS)
Features: Pale and soft meat



Formula 2 (5% DDGS)
Features: Pale and soft meat



Formula 3 (10% DDGS)
Features: Pale and soft meat



Formula 4 (15% DDGS)
Features: Pale and soft meat

Results of analyses indicated that there is no different in composition of the fish after feeding diets containing different level of DDGS. Fat content in whole fish was not different among the treatment and similar to protein content. DDGS has been reported to contain higher xantophyll level than that found in corn. The yellow color in DDGS may have an effect to color of the flesh; however color of fish is not affected by feeding DDGS as presented in Figure 3.

Conclusion

DDGS can be fed to growing common carp to 15%; however there is an indication that feeding at 10-15% gave a faster growth rate than that fed 0 and 5%. Feeding DDGS up to 15% in the diet for 3 months did not affect fish chemical composition and color of fish.

Acknowledgements

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Use of Dried Distiller Grains with Solubles (DDGS)for feeding Red Tilapia under Vietnam condition

Use of Dried Distiller Grains with Solubles (DDGS) for feeding Red Tilapia under Vietnam condition

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Summary

Feeding trial on tilapia has been conducted in a fish farmer in Hanoi, Vietnam to measure the optimum inclusion of Dried Distiller Grain Solubles in the feed. The trial was performed using tilapia fish with initial weight 190g raised for 4 month up to around 800-900g in floating cages placed in a reservoir. Four dietary treatments containing DDGS at 0, 5, 10 and 15% were included in similar dietary energy (2500kcal/kg) and protein level (30%) of feed composed mainly with soybean meal, corn, rice bran and fish oil. Results of feeding for 4 months showed that increasing level of DDGS in Tilapia diet increased growth rate and improve feed efficiency. The best performance was found when DDGS is included at 15% in combination with soybean meal. The use of DDGS also improves survivability of the fish from 94% in treatment without DDGS to 97.3% in treatment with 15% DDGS inclusion. Fish meat evaluation at end of trial indicated no different in chemical composition. In conclusion the DDGS can be included in Tilapia diet up to 15% and may improve the growth performance.

Introduction

Red tilapia is one of major fish grown in Vietnam and is considered popular species for human consumption. It is grown in a pond water or cage system in reservoir. Red tilapia is cultured until market size in the range of 500-800g. Red tilapia feed is commonly made of several ingredients such as soybean meal, wheat by products, fish meal, rice by product etc. Dried Distillers Grains and Soluble is by product of ethanol production made of corn and produced in a significant amount in US and other countries. It has been shown to be economically feasible for animal feed especially in dairy cattle, swine and poultry. However, information on the use of DDGS for feeding fish is limited, despite a high protein content (28%) and relatively cheaper cost of feed ingredients. With increasing of DDGS production in USA, the availability of DDGS for export to SEA will increase. Information on feeding value of DDGS for Tilapia would be useful for fish farmers in the region. It is expected that such type of information can be generated locally under South East Asia condition.

Aim

Determine the impact of feeding increasing levels of Corn Distillers Dried Grains and Solubles (DDGS) on the performance of Tilapia fish reared under commercial conditions in Vietnam.

Methodology

Feeding trial was carried out at experimental farm of Le Hung Vy, Binh Son, Song Cong district, Thai Nguyen Province, Vietnam. Feeding trial comprises 4 dietary treatments comprise:

- DDGS 0%. Control diet without DDGS contains only vegetable protein
- DDGS 5%. Diet contains 5 % DDGS
- DDGS 10%. Diet contains 10% DDGS
- DDGS 15%. Diet contains 15 % DDGS

Feed for trial was manufactured at Research Institute for Aquaculture facility in Hanoi using locally available ingredients either produced locally or imported. Dietary formula containing 0,5,10 and 15% of DDGS is presented in Table 1.

The dietary formulas contained similar Digestible Energy and Crude Protein value include amino acids. The feed was processed using wet extruder to produce complete feed in floating form. The size of pellet was 3-4mm. Each dietary treatment was fed to red tilapia fish at size 50g. The fish was grown in floating cage made of nylon net (mesh 1) at size 2x2x2m (effective volume for water 6 m3) containing 400 fish per cage. Each treatment was replicated 3 times and the trial was performed for 4 months to reach marketable size which approximately 800 g.

Feeding system

At least 6000 fingerling of common carp and tilapia at size 190g (12 cages x 400 fish=4800) was purchased from supplier and was adapted in the cages before the trial is started. Initially feed was offered at 5% biomass and fed 4 times per day at 7:30am, 10:30am, 13:30pm and 15:00pm. Amount of feed given was based on 95% satiation. Initial of feed was given at amount that can be consumed by fish within 10 minutes multiplied by 90%

Table 1 Dietary composition and calculated nutrient of tilapia feed containing different level of DDGS

	DDGS 0%	DDGS 5%	DDGS 10%	DDGS 15%
Soybean Meal 47	58.54	56.58	56.37	57.85
Corn Yellow	23.56	28.15	27.13	20.72
Rice Bran 10	11.41	3.75	0.00	0.00
Fish Oil	2.89	2.88	2.87	2.87
Mono Cal. Phos (21)	2.49	2.53	2.51	2.46
Vitamin Mix	0.50	0.50	0.50	0.50
Mineral Mix	0.25	0.25	0.25	0.25
Choline Chloride (60%)	0.20	0.20	0.20	0.20
Antimold	0.10	0.10	0.10	0.10
Antioxidant	0.03	0.03	0.03	0.03
Stay C 35	0.03	0.03	0.03	0.03
DDGS (Distillers Grain Solubles)	0.00	5.00	10.00	15.00
Calculated Nutrient				
CRUDE PROT (%)	29.87	29.68	30.32	31.77
FAT(%)	6.87	6.37	6.23	6.45
FIBRE (%)	4.38	3.99	3.96	4.26
Calcium (%)	0.54	0.54	0.54	0.54
Av. Phosphorus Fish (%)	0.49	0.50	0.50	0.48
Total Phosphorus (%)	1.15	1.07	1.04	1.07
LYSINE (%)	1.75	1.71	1.72	1.79
METHIONINE (%)	0.42	0.43	0.44	0.47
MET. + CYS. (%)	0.90	0.91	0.95	1.00
TRYPTOPHAN (%)	0.38	0.38	0.38	0.40
THREONINE (%)	1.15	1.15	1.18	1.25
Magnesium (%)	0.27	0.24	0.23	0.24
Dig. Energy Fish(Carp) (kcal/kg)	2465	2442	2484	2588
Dig. Protein Fish (%)	25.95	25.70	26.15	27.24
DE/DP Fish	95	95	95	95
Starch (%)	20.28	22.26	20.73	15.83
wn:3 total (%)	0.90	0.90	0.90	0.90
wn:6 total (%)	0.52	0.45	0.55	0.80
Vitamin C (ppm)	105	105	105	105

and was given in that amount for 5 days. The following 5 days was given at full amount therefore the average would be 95% satiation. This calculation was repeated again for every 10 days period. All feed was placed in special feeding boxes and cages were covered by nylon net to prevent an escape.

Measurement

Fish was sampled and weighed every month while total weighing was performed when they reach market size at approximately 800g. The daily mortality and feed consumption was recorded. At end of trial, three red tilapia from each treatment were randomly selected for analyzing the nutritional value in the red tilapia meat by measuring the protein, fat and ash content of fish. Feed conversion ratio was calculated and corrected for the mortality weight. Cost of feed per kg body weight gain was calculated. Samples of feed (250g) was collected and analyzed in laboratory.

Statistical Analyses

Randomized Completely Design with 4 treatments and 5 replicates containing 600 fishes per replicate cage was used in this trial for each species of fish. Data was analyzed using computer program and any significant different due to the treatment was further analyzed using Duncan.

Results and Discussion

Body weight change in tilapia during feeding different level of DDGS for 4 month period is presented in Figure 1. Body weight increased as fish grow as expected, variation in fish growth seemed to low in this trial as demonstrated in standard deviation of the graph. Feeding with increasing level of DDGS showed a better growth rate and it was noticed after feeding for 2 months. Feed containing DDGS was readily consumed by tilapia which may indicate that there was no palatability problem associated with DDGS in feed. There was no indication of disease in fish during the trial period.

Performance of red tilapia after feeding Dried Distillers Grains and Solubles at different level is presented in Table 2.

Figure 1 Growth performances of red tilapia fed different level of DDGS during 4 month culture period (Error bars are standard deviation of mean-SE values)

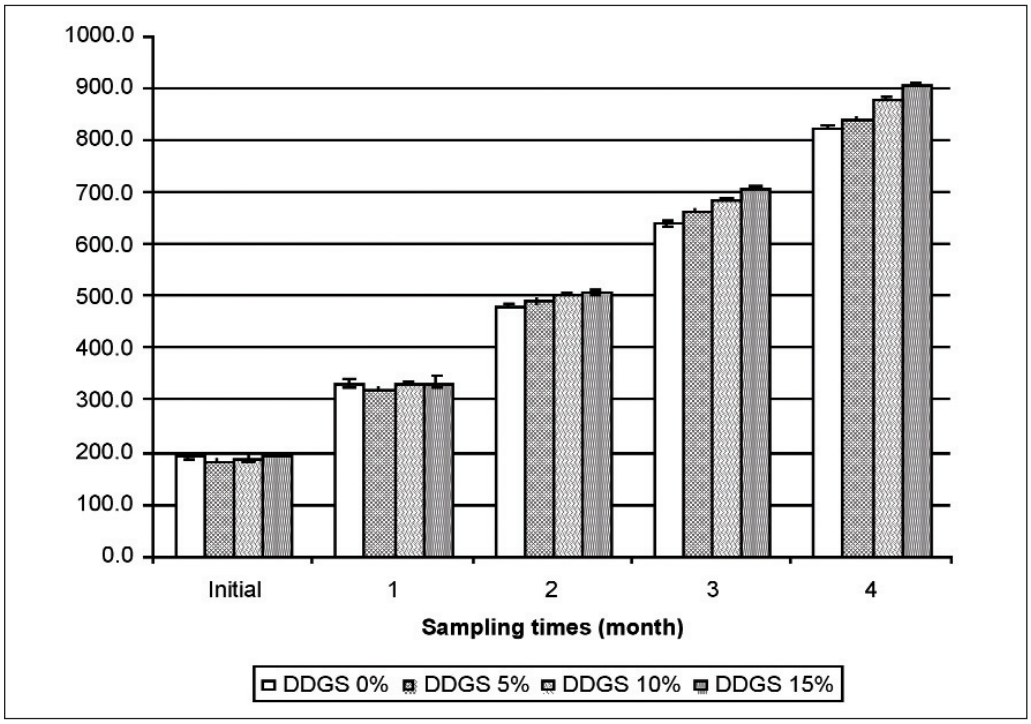

Table 2 Performance of Red Tilapia fed different of DDGS after 4 month culture period (mean values)

Descriptions	DDGS 0%	DDGS 5%	DDGS 10%	DDGS 15%	SEM
No. of fish	400	400	400	400	
Ave initial weight (g)	193.5	184.4	190.0	192.5	5.6
Total Initial weight (kg/cage)	77.6	73.6	76.0	77.2	
Number tilapia at harvest	376	381	389	389	
Ave weight at harvest (g)	824.2[a]	839.3[b]	879.4[c]	907.4[d]	3.2
Total biomass at harvest (kg)	309.8	319.7	342.3	353.2	
Ave weight gain (g)	630.7[a]	654.9[b]	689.4[c]	714.9[d]	5.0
Total feed consumed (kg)	575.8	575.8	575.8	575.8	
Feed Conversion Ratio	2.48[a]	2.34[b]	2.16[c]	2.09[d]	0.02
Mortality rate (%)	5.9[a]	4.8[b]	2.7[c]	2.8[c]	0.2
Survival rate (%)	94.1	95.2	97.3	97.2	

*different superscript at the same row is significant different (P<0.01), SEM = standard error means

Results of the trial indicated that fish growth rate increased as level of DDGS in the diet increase, body weight of tilapia after feeding 15% DDGS was 908 g compare to 824 g for fish fed without DDGS. Total feed consumption was not different among the treatments and these resulted on better feed conversion ration when DDGS was included in the diet. FCR decrease from 2.5 in treatment without DDGS to 2.1 when DDGS was included at 15%. Increasing DDGS level would also improve survivability of tilapia, mortality was decreased from 6% in control diet to only 2.8% in treatment with 15% DDGS. It would be interesting to get study if further increase in DDGS inclusion > 15% still give better improvement in performance.

Improvement in performance of tilapia when DDGS was included in the diet is not known, solubles in DDGS may contain substances that may promote healthiness of fish. Feeding of DDGS to pig has been reported to improve ileitis of pigs, cell wall component of yeast that present in solubles may also improve the immunity. Further studies on immunity on fish, however, are warranted.

Proximate composition of feed during the trial period is presented in Table 3. The feed was manufactured according to the formula every month to prevent spoilage and to freshness of feed. The expected composition of the feed is in agreement with calculated analyses presented in Table 1, except for fat content. The fat level in Table 3 was analyzed using soxhlet extraction using ether and it may cause a lower result than expected. Different method of analysis may have different result, for extruded feed, AOAC suggested using acid hydrolysis prior to extraction.

Table 3 Proximate composition of feed analyzed from different batch of manufacturing during the trial period

Dietary Treatment	Moisture %	Crude Protein %	Ash %	Fat %
1st Batch				
DDGS 0%	9.35	32.08	7.41	3.51
DDGS 5%	9.18	32.23	6.05	4.93
DDGS 10%	8.25	33.46	6.43	4.42
DDGS 15%	9.78	33.87	6.54	4.07
2nd Batch				
DDGS 0%	9.62	32.32	6.54	4.26
DDGS 5%	9.24	32.11	6.62	4.55
DDGS 10%	9.13	32.07	6.71	4.52
DDGS 15%	9.36	32.25	6.63	4.42
3rd Batch				
DDGS 0%	9.81	32.52	7.10	3.57
DDGS 5%	9.52	31.90	6.10	4.21
DDGS 10%	9.85	31.96	6.22	3.50
DDGS 15%	9.57	32.09	5.96	4.38
4th Batch				
DDGS 0%	10.62	32.52	6.90	3.21
DDGS 5%	10.79	31.90	6.12	4.00
DDGS 10%	10.07	31.96	6.23	3.34
DDGS 15%	10.11	32.09	6.45	4.05

Table 4 Nutritional composition of tilapia meat fed different level of DDGS

Treatments	Dry matter %	Protein %	Lipid %	Ash %
DDGS 0%	28.64	17.36	8.91	3.47
DDGS 5%	29.93	16.79	9.28	3.82
DDGS 10%	30.16	17.05	8.92	4.07
DDGS 15%	29.97	15.96	5.63	4.24

Composition of tilapia after feeding DDGS at different levels is presented in Table 4.

Results of analyses indicated that there is no different in composition of the fish after feeding diets containing different level of DDGS. DDGS contains xantophyll that may have an effect to color of the flesh, however xantophyll analyses has not been performed in this trial. Further study on the effect of xantophyll in DDGS to fish quality may be necessary.

Conclusion

After 4 month culture period, the best growth rates of red tilapia were obtained in the 10% and 15% DDGS feed treatments ($P<0.05$). The lowest growth rate was presented in the 0% DDGS feed. The lowest FCR of for whole culture period was obtained to be 2.1 which is presented in the treatment of 15% DDGS feed treatment. The highest survival rates (97.3%) were also obtained in the 10 and 15% DDGS treatments. There was no effect of feeding DDGS up to 15% on fish chemical composition.

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