Report on the Feeding Trial and the Usage of DDGS in Aquaculture Fish Diets

September 30, 2010

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1) Aquaculture in Japan

The following tables describe changes in fish production volume of the Japan's aquaculture industry and the production volumes by fish species for 2008 and 2009 (published by the Statistics Department of the Minister's Secretariat of Agriculture, Forestry and Fisheries on April 30, 2010):

Year	Seawater fish aquaculture	Inland water fish aquaculture
2000	259	61
2001	264	56
2002	268	51
2003	274	50
2004	262	45
2005	269	42
2006	258	41
2007	262	42
2008	260	40
2009	260	41
(Unit: 1,000 tons)		

Fish species	2009	2008	Fish species	2009	2008
Seawater fish aquaculture total	260,100	260,100	Inland water fish aquaculture total	41,187	40,012
Silver salmon	15,800	12,800	Trout	10,003	9,951
Yellowtail	152,800	155,100	(Rainbow trout)	6,659	6,825
Saurel	1,600	1,700	(Other species of trout)	3,345	3,126
Garganey	2,500	2,600	Sweetfish	5,667	5,940
Red sea-bream	69,700	71,600	Carp	3,045	298,1
Flatfish	4,300	4,200	Eel	22,404	20,952
Globefish	4,600	4,100	Other fishes	68	188
Other fishes	8,800	8,000			
(Unit: tons)			(Unit: ton)		

The above tables show that how much fish production of the inland water aquaculture has been declining in these 10 years. This is due to significantly low fish prices resulted from the recent slowdown of the economy, which, however, can be said about both sea-water aquaculture and fresh-water aquaculture.

It is said that feed costs account for about one-third of all costs of aquaculture producers. The main ingredient of fish diets is fishmeal in Japan. Except for diets for herbivorous fish, the major ingredient of typical fish diets is fishmeal. It has been reported that researches to reduce the inclusion of fishmeal in livestock diets have been conducted early on, but not in the fish feed industry because of its smaller market and fewer researchers. Recently, the price of fishmeal is soaring in response to the rapid increase in demand of Asian countries, resulting in the unusually high feed prices.

(Refer to Two tables in slide 3 and 4 of Mr. Kobori's résumé (attachment 1))

The purpose of this experiment is to confirm whether any difference can be observed in the quality of the fish meat between fish fed with diets that are made from lower cost ingredients and those fed with fishmeal.

2) Experiment method

In general, conventional DDGSs contain not more than 30% CP, which makes them difficult to be used for formulation of fish diets and less attractive in terms of price of CP. Therefore, high protein DDGs produced by several U.S. companies were used for the experiment. The components of the diet are as shown in the table below:

	(%)
MOISTURE	6.29
CRUDE PROTEIN	49.02
ADF	8.01
NDF	14.46
LIGNIN	2.2
STARCH	4.13
FAT	1.9
ASH	4.5
CRUDE FIBER	3.55

The method of the experiment and feed ingredients and nutrients of sample diets are as shown in slide 3,4,5,6 of Mr. Yonehana's résumé (attachment 2).

3) Results

In the course of the experiment, there was an accident where some of fish died from a shortage of oxygen, caused by a clogged pipe in increased water after heavy rain, however, the experiment was successfully completed for all experimental groups.

The result is as shown in slide 8 and later of Mr. Yonehana's résumé (attachment 2).

4) Discussion

In all experimental groups, the highest feed efficiency of 87.6% was observed in Treatment A. When this is converted into feed cost, Treatment A can ensure about 10% lower feed cost per weight gain than Control A, (the calculation was made using a DDGS price of 65 yen per kilogram), which is resulted from replacing 15% of the fishmeal inclusion in the diets.

The meat color of sample fish often becomes yellowish when they are fed diets containing a high proportion of corn gluten meal, however, the fish group fed DDGS showed rather whitish meat color.

There was no difference in the palatability among all the experimental groups.

5) Outlook

The Japanese fish feed manufacturing industry has a deeply rooted “loyalty to fishmeal,” and tends to ignore proposals for employment of new feed ingredients. However, the recent higher fishmeal price is forcing them to consider the possibility of use of alternative ingredients.

It cannot be expected that the price of fishmeal will decline in the future, on the contrary, it will rise further because the ingredients of fishmeal, sardines and saurel are mainly produced in South America, the fishing of which is restricted under the fishing quota program.

Aquaculture fish account for a large portion of fish traded in the market. The rising fish feed prices and worsening economy, however, could reduce the producer’s incentive to continue as well as volumes traded in the market, which may result in the destruction of Japanese traditional fish eating culture.

The time has come for feed manufacturers and aquaculture producers to cooperate with each other to develop diets containing new protein ingredients replaceable with fishmeal.

6) Acknowledgement

I would like to express my gratitude to the U.S. Grains Council for their support for this research and Aichi Trout Farmers Cooperative Association for their cooperation in implementation of the experiment.

Attachment 1

Why we need DDGS for Aquaculture Feeds

Chairman Akihiko Kobori
Japan Trout Farmers Association

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2010.09.08 USGC DDGS Seminar

We Need Reduction in Fishmeal Use

① After Japan started importing fishmeal and dependent on it, trout feed price hiked including the EP type. The current level is 70% higher over 1997

② It totally resulted from steep rise in fishmeal price

③ Producers can not pass the additional cost on the price of final products

④ Reduction in sales→Reduction in production→Management exhaustion

⑤ We need a rapid-acting solution

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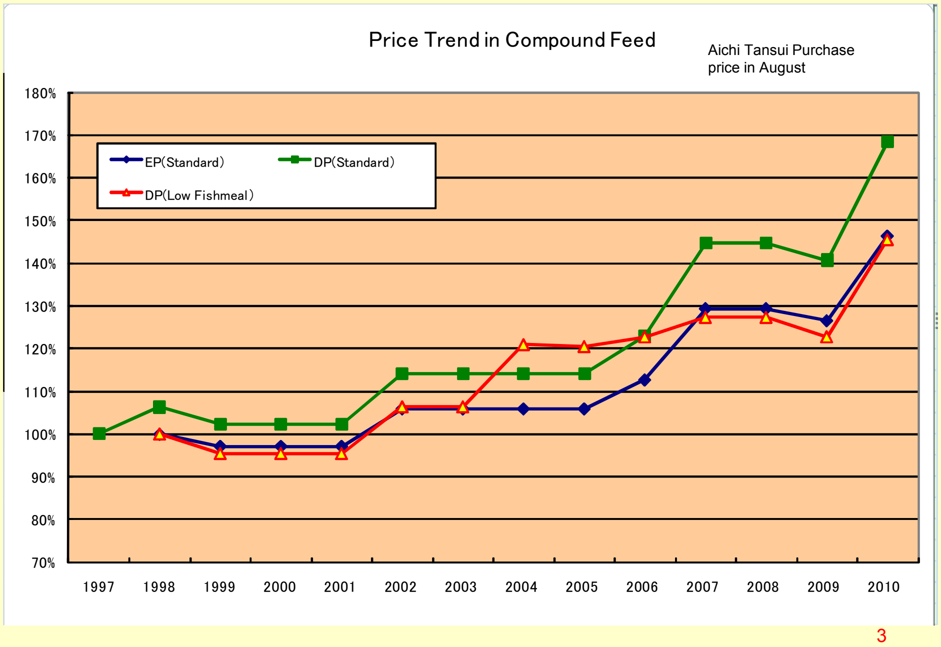
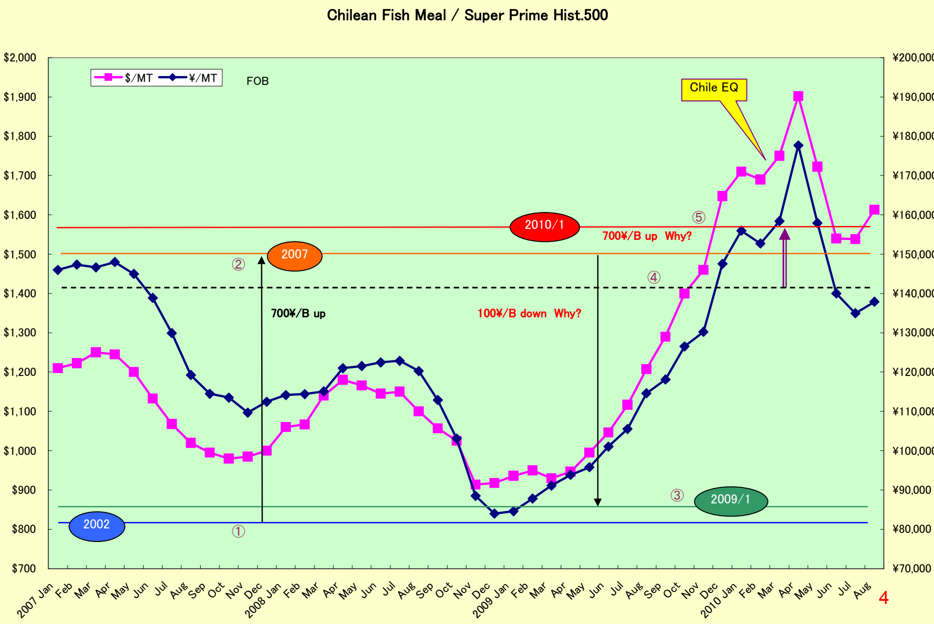
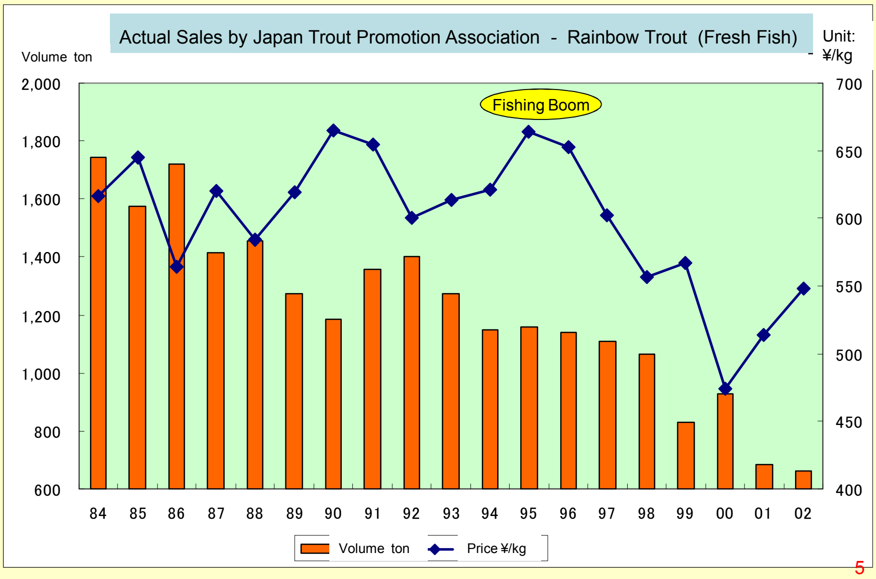


Trend in Fishmeal Price



Price and Sales Trends of Rainbow Trout in Tokyo Market



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Background of our efforts in lowering inclusion of fishmeal

- Cost of fishmeal imports is driven by weather, fishing rule, global demands, foreign exchange, etc.
- Since fishmeal is the main ingredient of fish feed, its reduction can make a large impact to the feed cost
- No more the scenario “high fishmeal→higher growth→higher production→higher sales→higher income”
- Higher production does not always result higher income
- Production just matches the seasonal demand is the best →Priority is reduction in feed cost rather than high productivity
- Fishmeal is main ingredient for aquaculture, while it is minor ingredient for livestock. Fish farmers are handicapped in price competition in the food business arena
- Production cost can not pass on the price of final product
- Higher feed cost directly results in lower profit
- We need alternative feed for replacing flexibly responding to the production environment

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Development of New Compound Feed for Trout

- Price fluctuation in fish meal is greater than that in plant-derived ingredients
- With lowering fishmeal use, fluctuation range can be reduced, even if the price itself can not be lowered so much
- Higher fishmeal=expensive feed=good performance ≠ profits
- In Japan, we can not use animal protein such as MBM, MP, under the circumstance (BSE issue)
- Current crisis is an opportunity to renew our feed formula
- Many to chose for alternative such as protein concentration
- Amino Acid balance can be adjusted with crystal AA

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Background of Using DDGS as an Alternative

① Other alternatives such as animal rendering were too expensive

② MM･MBM→difficult to use after outbreak of BSE

③ SBM･･･Challenge is trypsin inhibitor

④ CGM･･･Challenge is coloring in muscle or/and skin

What is the limit of ② and ③ inclusion level

Another alternative – DDGS

How stable is the level of CP, and CP unit cost?

How is the coloring effect to skin and muscle?

How digestible? Any change in volume and weigh of feces

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Attachment 2

DDGS Feeding Trial

DDGS Use in Farming Rainbow Trout

Akio Yonehana, Executive Director
Aichi Trout Farmers Cooperative Association

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1.Objectives of the trial

we has been looking for alternative protein source since the price of fishmeal surged, and recognized that the bioethanol production supplies corn DDGS in significant volume, which indicated us a possibility of use for aquaculture.

However, the conventional DDGS ' protein content is only 30% and varies. Then we found the Hi-Pro DDGS (BP50) with stable CP content about 50%. We started feeding trial to see its efficiency.

Other alternatives :SBM･･･Limit factor is trypsin inhibitor, and CGM･･･coloring in muscle and skin.

We started test of replacing CGM and a part of fishmeal with, DDGS(BP50) to see the efficiency.

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2. The Test design

Test 1：Identical feed ratio
Test 2：Identical feed volume

2-1 Test method

	Test 1	Test 2
Fish	Rainbow trout	
Initial weight	23.8g ±0.6g	52.5g
# of fish	1,000 / each group	571 / each group
Water tank	90×600×50cm（water：2,700 ℓ）	
Water temperature	8.0～18.6℃	16.0～20.5℃
Water input	2.86ℓ/sec	
Water turnover	3.81turns/h	
Feeding period	2010/5/1～2010/7/16(77days)	2010/8/2～8/31（30days）（on going）
Feeding method	Twice/day（the same ratio）	Twice/day（the same feed amount）
Measurement	Measure each 10 days and adjust the feed volume	
Feed form	EP	

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Test Tank


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2-2 Trial Feeds

Test feed	Control A (Seseragi)	DDGS A	Control B (Puff Clean Aichi)	DDGS B
Size	#3	#3	#3	#3
Feed form	EP	EP	EP	EP
Feed mill	Chita Factory	Chita Factory	Chita Factory	Chita Factory
Animal protein(%)	57.0	41.0	35.0	35.0
	Fishmeal	Fishmeal	Fishmeal	Fishmeal
Cereal Grains (%)	20.0	20.0	20.0	20.0
	Wheat	Wheat	Wheat	Wheat
		(Starch)	(Starch)	(Starch)
Plant deried meals (%)	10.0	10.0	26.0	14.0
	SBM	SBM	SBM	SBM
	CGM	CGM	CGM	
Other by products	7.0	20.0	11.0	20.0
	Rice bran	DDGS	Rice bran	DDGS
			Wheat bran	
		Rice bran	lysine fermented meal	Rice bran
			Glutamine fermented meal	lysine fermented meal
				Glutamine fermented meal
Others (%)	6.0	9.0	8.0	11.0
	Refined fish oil	Refined fish oil	Soy germ	Soy germ
	Feed yiest	Feed yiest	Charcoal	Charcoal
	er of Sasa "*Sasa veit*	er of Sasa "*Sasa veit*	Wood vinegar	Wood vinegar
	Calcium phosphate	Calcium phosphate	Feed yiest	Feed yiest
	specific fungus powde	specific fungus powde	Citric acid	Citric acid
	(vege oil)	(vege oil)	der of Sasa "*Sasa veitc*	er of Sasa "*Sasa veit*
			Calcium phosphate	Calcium phosphate
			Sodium	Sodium
Composition	Control A (Seseragi)	DDGS A	Control B (Puff Clean Aichi)	DDGS B
> CP %	46.0	44.0	43.0	43.0
> CF %	10.0	10.0	4.0	4.0
< Crude Fiber %	3.0	3.0	4.0	4.0
< Crude Ash %	15.0	15.0	13.0	13.0
> Calcium %	1.5	1.5	1.0	1.0
> Phosphorus %	1.2	1.2	1.0	1.0
> Moisture %	9.0	9.0	9.0	9.0
> NFE %	17.0	19.0	27.0	27.0
ME (Kcal/kg)	3,144	3,148	2,776	2,766
ME balance	100	100	88	88
Feed price index (Feb.)	100	93	76	75

＊ Feed price index fluctuates with price of ingredients

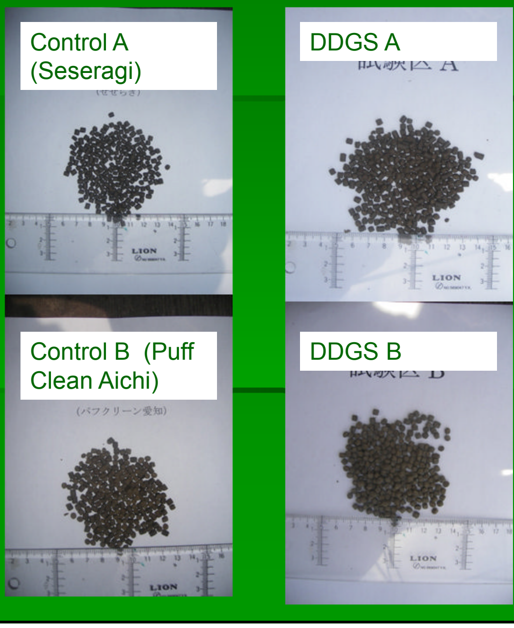
Feed Composition	Control A (Seseragi)	DDGS A	Control B (Puff Clean Aichi)	DDGC B
> CP %	46.0	44.0	43.0	43.0
> CF %	10.0	10.0	4.0	4.0
< Crude Fiber %	3.0	3.0	4.0	4.0
< Cruce Ash %	15.0	15.0	13.0	13.0
> Calcium %	1.5	1.5	1.0	1.0
> Phosphorus %	1.2	1.2	1.0	1.0
> Moisture %	9.0	9.0	9.0	9.0
> NFE %	17.0	19.0	27.0	27.0
ME balance (Kcal/kg)	3,144	3,148	2,776	2,766
ME balance	100	100	88	88
Feed price index (Feb.)	100	93	76	75

＊ Feed price index fluctuates with price movement of feed ingredients

Amino Acid Composition

	Control A (Seseragi)	DDGS A	Control B (Puff Clean Aichi)	DDGS B
Arginine	2.6	2.4	2.3	2.4
Lysine	3.3	2.9	2.6	2.8
Methionine	1.2	1.1	0.9	0.9
Cystine	0.6	0.7	0.6	0.7
Tryptophan	0.6	0.5	0.5	0.5
Giysine	2.4	2.2	1.9	1.9
Phenylalanine	2.0	2.0	1.9	1.8
Threonine	1.6	1.6	1.5	1.4
Isoleucine	2.0	1.8	1.8	1.8
Tyrosine	1.8	1.8	1.5	1.6

Trial Feeds



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3.Results

3-1 Trial 1

	Control A	DDGS A	Control B	DDGS B
Average initial weight	24.4g	23.6g	23.2g	24.0g
Average final weight	98.3g	92.1g	75.0g	73.8g
Weight gain	70.1kg	68.7kg	51.4kg	49.3kg
Total feed	81,386g	75,342g	65,693g	65,738g
Feed conversion ratio	86.1%	91.2%	78.3%	75.0%

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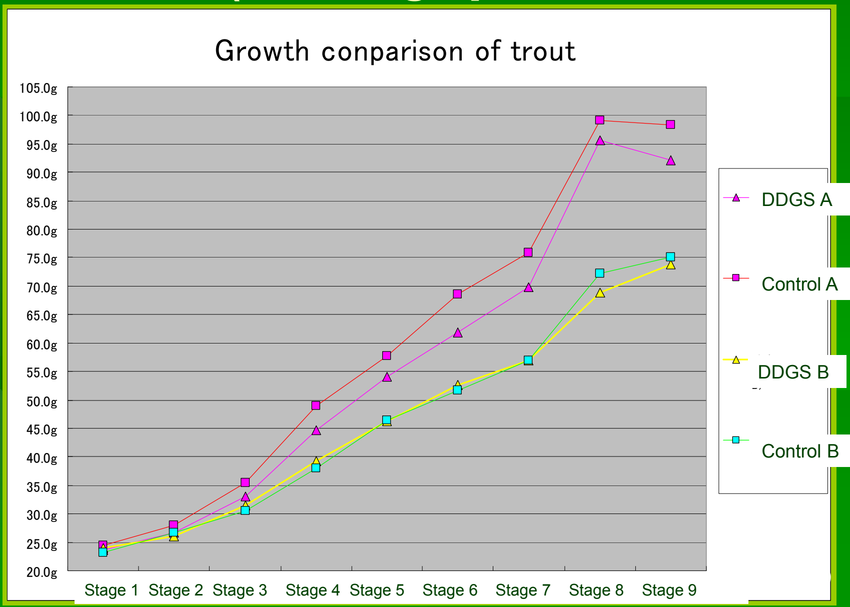
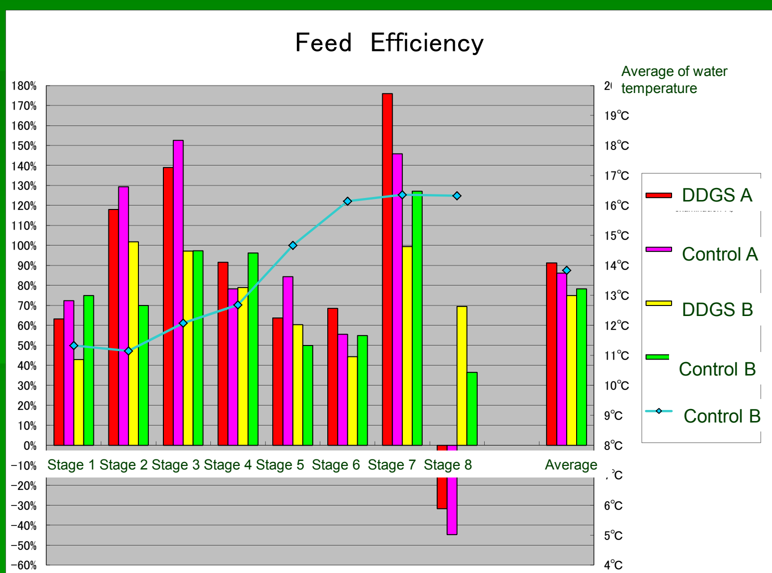
3-1 Trial 1 (Growth graph)



3-1 Trial 1 (Feed Conversion ratio)



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3-2 Trial 2

	Control A	DDGS A	Control B	DDGS B
Average initial weight	52.5g	52.5g	52.5g	52.5g
Average final weight	86.6g	84.3g	80.3g	78.2g
Total weight gain	18.5kg	17.3kg	15.0kg	13.6kg
Total feed	22,787g	22,787g	22,787g	22,787g
Feed conversion ratio	81.2%	75.9%	66.0%	59.8%

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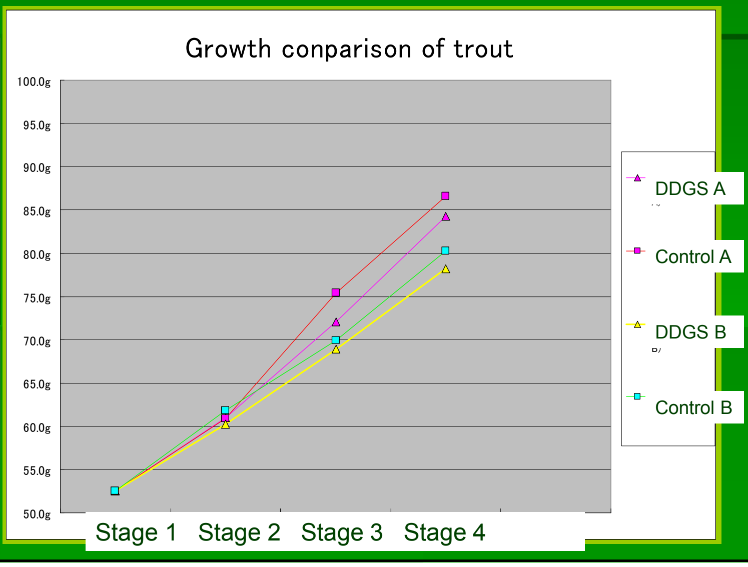
3-2 The Second Trial Result



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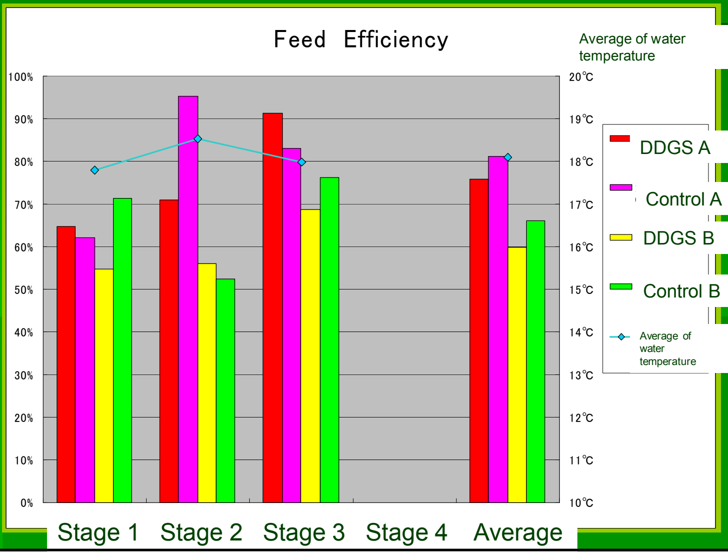
3-2 Trial 2 (Feed Conversion）



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3-3 Rainbow Trout at Harvest

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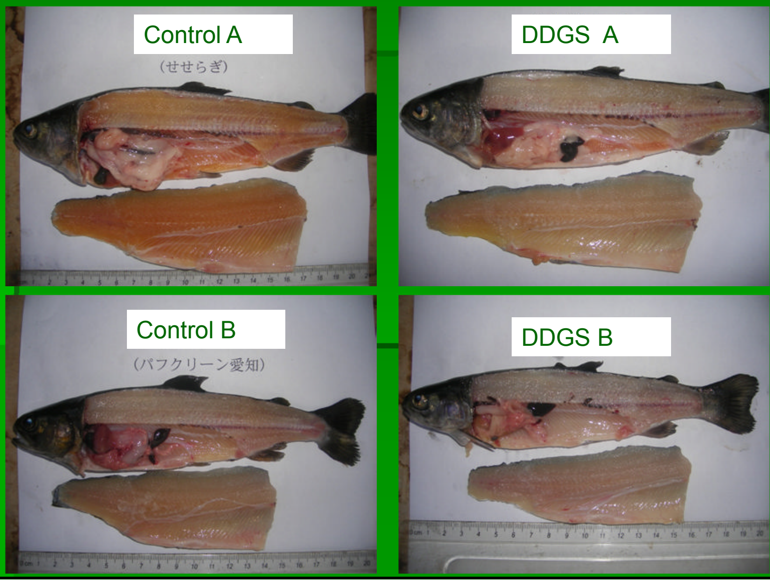
3-4 Meat Color at Harvest



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4. Consideration

Total of Trial 1 and 2	Control A	DDGS A	Control B	DDGS B
Total weight gain	88.6kg	86.0kg	66.4kg	62.9kg
Total feed	104,173g	98,129g	88,480g	88,525g
Feed conversion ratio	85.0%	87.6%	75.1%	71.0%
Feed price index	100	93	76	75
Feed weight / 1 kg weigt gain	1.176kg	1.141kg	1.332kg	1.408kg
Feed cost / 1 kg weight gain	117.62	106.14	101.23	105.58
Feed cost index for 1 kg weight gain	100	90.2	86.1	89.8

- Results of trials: We could lower the feed cost by 10% with replacement of fishmeal15% with DDGS (BP50). Replacing CGM 12%, feed conversion ratio lowered by 4.1%, but feed cost lowered with 3.7% only.
- There was no yellow-coloring in muscle. Fish meat was whiter in groups fed with corn derived ingredients.
- There was no difference in palatability

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4.Consideration

- Now on, we need to develop compound feeds utilizing the new fishmeal alternatives such as DDGS(BP50), SBM and CGM, so that aquaculture farmers can cost wisely produce fish changing formula of feed ingredients responding to the feed price flexibly !
- Aquaculture farmers should learn more about fishmeal situation, so that they can be able to master and skillfully utilize those fishmeal alternatives in compound feed.

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Lastly:

I like to express our thanks to the U.S. Grains Council, Nippon Formula Feed Mfg Co., Ltd, BX Shoukai Co., Ltd. and Shinto Trading Co., Ltd. for your understanding and cooperation to the trials.

Thank you.

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