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Feeding Trials with Carp Fed Amino Acid Diets of Several Types by Increasing the Number of Feedings per Day.

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Abstract

Three feeding trials were conducted to examine feed efficiency of amino acid diets of agar-gel type, paste type and dry pellet type in carp fed by increasing the number of feedings per day.

The casein diets produced excellent feed efficiency regardless of the types. In the amino acid diets of agar-gel and paste types, to increase the number of feedings per day had no effect on feed efficiency. However, in the diet of dry pellet type, the amino acid diet produced high feed efficiency in carp fed 18 times, compared with carp fed 3 times a day.

Several workers¹⁻⁴⁾ have reported that amino acid diets are unable to sustain normal growth of young carp. However, we have shown that the feed efficiency of the amino acid diet of a dry pellet type for carp was improved by increasing the number of feedings per day⁵⁾.

The purpose of this paper has been to examine the feed efficiency of the amino acid diets of agar-gel type, paste type and dry pellet type in carp fed by increasing the number of feedings per day.

Materials and Methods

The composition of the test diets used in trials 1, 2 and 3 is given in Table 1. The amino acid mixture, vitamins and minerals were the same as those used in our previous work⁶⁾. The preparation of "CA-agar" and "AA-agar" diets in trial 1, and "CA-pellet" and "AA-pellet" diets in trial 3 were the same as those used in the previous work⁶⁾. "CA-paste" diet in trial 2 was prepared by kneading thoroughly after adding 65 ml of water to 100 g of the dry ingredients. Similarly, "AA-paste" diet was prepared by kneading after adding 25 ml of 5N NaOH solution and 5 ml of water to give a final pH of 7.

Young carp, *Cyprinus carpio*, were obtained from Ibusuki Branch, Kagoshima Prefecture Fisheries Experimental Research Station and kept in a 0.2 ton polyvinyl chloride tank on a commercial diet. One week before each trial started, the fish were transferred to the experimental tanks and fed the pellet diet containing 25 % casein, 25 % amino acid mixture

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Table 1. Composition of the test diets used in trials 1,2 and 3

(g/100 g diet)

Trials Diets	1		2		3	
	"CA-agar"	"AA-agar"	"CA-paste"	"AA-paste"	"CA-pellet"	"AA-pellet"
Casein, vitamin-free	50	—	50	—	50	—
Amino acid mixture	—	50	—	50	—	50
Dextrin	29.5	29.5	29.5	29.5	20	20
α -Starch (potate)	—	—	—	—	8	8
Pollack liver oil	6	6	6	6	6	6
Vitamins	3	3	3	3	3	3
Minerals	4	4	4	4	4	4
Agar-agar	7.5	7.5	—	—	—	—
CMC	—	—	7.5*1	7.5*1	2*2	2*2
α -Cellulose	—	—	—	—	7	7

*1 Sunrose F-1000 LC (Sanyo Kokusaku Parupu Co., Ltd.)

*2 Serogen WSA (Daiichi Kogyo Seiyaku Co., Ltd.)

Table 2. Condition of trials 1,2 and 3

	Trial		
	1	2	3
Number of fish per tank at start	28	19	20
Average body weight at start	6.0 g	8.5 g	10.0 g
Feeding period (weeks)	4	4	4
Daily amount of dry diet fed (% of total body wt.)	3%	5%	3%
Water temperature	22°C	22°C	24°C
Experimental tank	polyvinyl chloride tank (60×30×30cm)		

and 50 % other ingredients, in order to acclimate to the experimental conditions.

In trial 1, "CA-agar" diet was fed to 3 times daily (at 3.5 hour intervals). "AA-agar" diet was fed to 3 (3.5 hours), 8 (1 hour), 16 (30 minutes) or 24 (20 minutes) times daily, 6 days weekly for 4 weeks under the condition as shown in Table 2. Similarly, in trial 2, "CA-paste" diet was fed to 3 times daily (3.5 hours). "AA-paste" diet was fed to 3 (3.5 hours), 12 (40 minutes) or 24 (20 minutes) times daily. In trial 3, "CA-pellet" diet was fed to 3 times daily (3.5 hours). "AA-pellet" diet was fed to 3 (3.5 hours) or 18 (30 minutes) times daily.

Data were evaluated by analysis of variance statistics and means were compared with "t"-test, Cochran-cox test or Duncan's multiple-range test ($P < 0.05$).

Results and Discussion

The results of trials 1, 2 and 3 are shown in Tables 3, 4 and 5 respectively. The casein diet could produce high feed efficiency (over 100 %) regardless of the types ("CA-agar", "CA-paste" or "CA-pellet"). In Table 3, when carp were fed "AA-agar" diet 3 times a day, feed efficiency was about 60 % (2-4 week). There was no significant difference in average body weight after 4 weeks among "AA-agar" groups (3, 8, 16 and 24 feeding frequency). As

Table 3. Results of trial 1

Diets	"CA-agar"		"AA-agar"		
	3	3	8	16	24
Feeding frequency					
No. of fish					
at start	28	28	28	28	28
after 4 weeks	28	28	28	28	28
Av. body weight (g)					
at start	5.97	6.28	6.10	6.17	6.08
±S.D.	±0.53	±0.55	±0.47	±0.51	±0.55
after 4 weeks *	10.59 ^b	8.76 ^a	8.80 ^a	8.61 ^a	8.75 ^a
±S.D.	±1.64	±0.95	±0.64	±0.96	±1.26
Feed efficiency (%)					
0 - 2 week	107.9	51.5	55.1	50.1	59.8
2 - 4 week	118.0	58.3	67.0	60.0	60.9

* Means not sharing a common superscript are significantly different at $P < 0.05$ or less.

Table 4. Results of trial 2

Diets	"CA-paste"		"AA-paste"	
	3	3	12	24
Feeding frequency				
No. of fish				
at start	19	19	19	19
after 4 weeks	19	19	19	19
Av. body weight (g)				
at start	8.52	8.59	8.50	8.55
±S.D.	±0.84	±0.77	±0.76	±0.83
after 4 weeks *	21.61 ^b	12.49 ^a	12.93 ^a	12.48 ^a
±S.D.	±2.30	±1.40	±1.61	±1.86
Feed efficiency (%)				
0 - 2 week	114.5	39.8	57.6	51.8
2 - 4 week	101.2	35.2	37.4	24.7

* Means not sharing a common superscript are significantly different at $P < 0.05$ or less.

Table 5. Results of trial 3

Diets	"CA-pellet"		"AA-pellet"	
	3	3	18	
Feeding frequency				
No. of fish				
at start	20	20	20	
after 4 weeks	20	20	20	
Av. body weight (g)				
at start	9.86	9.99	9.91	
±S.D.	±0.91	±0.79	±0.82	
after 4 weeks *	19.22 ^c	12.58 ^a	14.02 ^b	
±S.D.	±2.60	±1.47	±1.82	
Feed efficiency (%)				
0 - 2 week	125.2	33.1	46.7	
2 - 4 week	115.0	41.2	68.6	

* Means not sharing a common superscript are significantly different at $P < 0.05$ or less.

feeding frequency increased up to 24 times a day, feed efficiency did not rise in the case of "AA-agar" diet (Table 3). Feed efficiency of "AA-paste" diet could not be improved by increasing the number of feedings per day (Table 4). However, in trial 3 which was undertaken in order to re-examine the previous study⁵⁾, there was significant difference in mean weight after 4-week feeding trial between 3 times and 18 times feeding groups in "AA-pellet" diet. When carp were fed 18 times a day, "AA-pellet" diet produced relatively high feed efficiency (68.6 %). This result was in accord with that obtained in the previous study⁵⁾.

We found a phenomenon that high percentage of amino acid was dissolved from an amino acid diet into water during feeding by carp, and assumed that the phenomenon caused low feed efficiency of an amino acid diet compared with that of a casein diet, when carp were fed under the condition of ordinary feeding frequency (3 or 4 times) per day. In "AA-agar" and "AA-paste" diets, the fact that increase in the number of feedings per day had no effect on feed efficiency in carp, may be explained from no difference in percentage loss (dissolving) of amino acids from the diet among treatments of feeding frequency. In only "AA-pellet" diet, the percentage loss of amino acids from the diet may decrease, as the feeding frequency per day increase (in other words, the amount of the diet fed at each feeding time decreases). Further work will be required to determine amino acid loss from the amino acid diets of these types during feeding by carp.

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