Comparison of the apparent digestibility coefficient among replicates and different stocking density in red sea bream, *Pagrus major*

Amal K. Biswas*, Manabu Seoka
(Fish Nutrition・Food Safety・Food Processing Group)
Fisheries Laboratory, Kinki University;
*ns_akb@nara.kindai.ac.jp

The apparent digestibility coefficient (ADC) is an important tool to investigate the digestibility performance of food ingredients used in aquaculture. The studies dealing with the digestibility are scarce in red sea bream *Pagrus major*, a species of great interest in Japan because of its multipurpose use[1]. However, a lot of studies have been conducted in other species using more than one replicate for each treatment[2,3]. However, it is necessary to investigate whether a single tank is sufficient to get reliable measurements for each treatment because the arrangement of more replicates is difficult in some situations.

In the digestibility experiment, fish were allowed to acclimatize to the allocated dietary treatments either one week[3,4] or two weeks[1,5] and others were acclimated more than two weeks[2]. However, there is no sufficient information on the effect of acclimation period on the digestibility performance. As much as we are aware, there is no information either on the variations in the ADC among the replicates of a treatment in different time course, or on the effect of stocking density on the ADC of different nutrients in red sea bream. Therefore, these areas are required to be investigated.

Materials and methods

About 120 juvenile red sea bream (mean weight = 20g) of the selected strain were obtained from the Fish Nursery Center of Kinki University, Uragami, Japan and distributed among three 400-l conical bottom shaped tanks for acclimation. After conditioning for one week, the stocking density was reduced to 35 fish (mean weight = 26.5 g) per tank. These tanks were used for fecal collection. The photoperiod in all tanks was set to 12-h light :12-h dark. Tanks were supplied with filtered seawater at a rate of 4 l/min and the temperature was maintained at 21±1℃. Fish were fed to apparent satiation with a diet established by Ukawa et al.[6] for red sea bream, except that 0.5% chromic oxide (Cr_2O_3) was added as an inert marker. Feces were collected on 9th, 10th and 11th day, 16th, 17th and 18th day, and 23rd, 24th and 25th day during 2nd, 3rd and 4th week, respectively. Fecal samples were collected at 08:30 h before the first feeding, freeze-dried and stored to freezer.

Another trial was carried out to investigate the effect of stocking density on the ADC of protein, lipid and energy in red sea bream. Fish were fed with similar diet. Fish were acclimated for three weeks and feces were sampled on 23rd, 24th and 25th day. Finally, the fish were starved for 24 h and the body length and weight were measured.

Apparent digestibility coefficient of

nutrients and energy were calculated and proximate analyses of samples were carried out. Gross energy of feces and whole body of fish was measured by bomb calorimetry (IKA-Warke GmbH & Co. KG, Germany). Finally, the results were compared among the treatments after statistical analysis. All statistical analyses were carried out using the SPSS program for Windows. The means were compared using Tukey's test with a 95% significant level.

Results & Discussion

There was no significant difference in ADC among the replicates during the course of the study (Fig. 1). The lack of significant difference in the ADC among the replicates suggests that a single tank could be sufficient to get reliable measurement from a treatment where it is difficult to arrange more replicates to investigate the digestibility performance. Although in different parameters, Ginés et al.[7] also observed no significant difference between the two tanks of a treatment at any time during the experiment and the regression line slopes for weight change were the same for both tanks. Similarly, no significant effect between replicate within treatments was observed in gilthead sea bream along large growth period[8,9]. The ADC of protein, lipid and ernergy at Day 3 was significantly higher than that of Day 1 in all tanks during the 2nd week ($P<0.05$, Fig. 1). This suggests that the ADC of a particular day does not necessarily represent the actual value when the fish are acclimated to the food for short period.

There was no significant difference in the ADC of protein, lipid and energy between 3rd and 4th weeks in all tanks, but the ADC of all parameters in both weeks was significantly higher than those of 2nd week (Fig. 1). This suggests that the fish should be acclimated to the food and fecal collection system for at least 3 weeks to achieve the best performance. However, there are a number of cases where fish were allowed to acclimate to the food either one or two weeks and even less than one week[1,3-5,10]. But, the results from this study seem to suggest that the acclimation period of less than 3 weeks may cause underestimation of the ADC of protein, lipid and energy at least in case of red sea bream.

Although a better digestibility performance was observed in the lower stocking density, there was no significant difference in the ADC of protein, lipid and energy among stocking densities ($P>0.05$). However, a lower stocking density showed better growth performance than the higher stocking density. This may be attributed to the fact that the increasing activity in the higher stocking density may be dissipated energy which resulted in lower weight gain. The decreasing weight gain with increasing stocking density was also observed in other species[11,12].

In conclusion, the results indicated that a single tank for each treatment can be used in the digestibility study only in those circumstances where the arrangement of more replicate is difficult or impossible. However, the fish should be acclimatized to the food and the fecal collection tank for at least 3 weeks to get more reliable data.

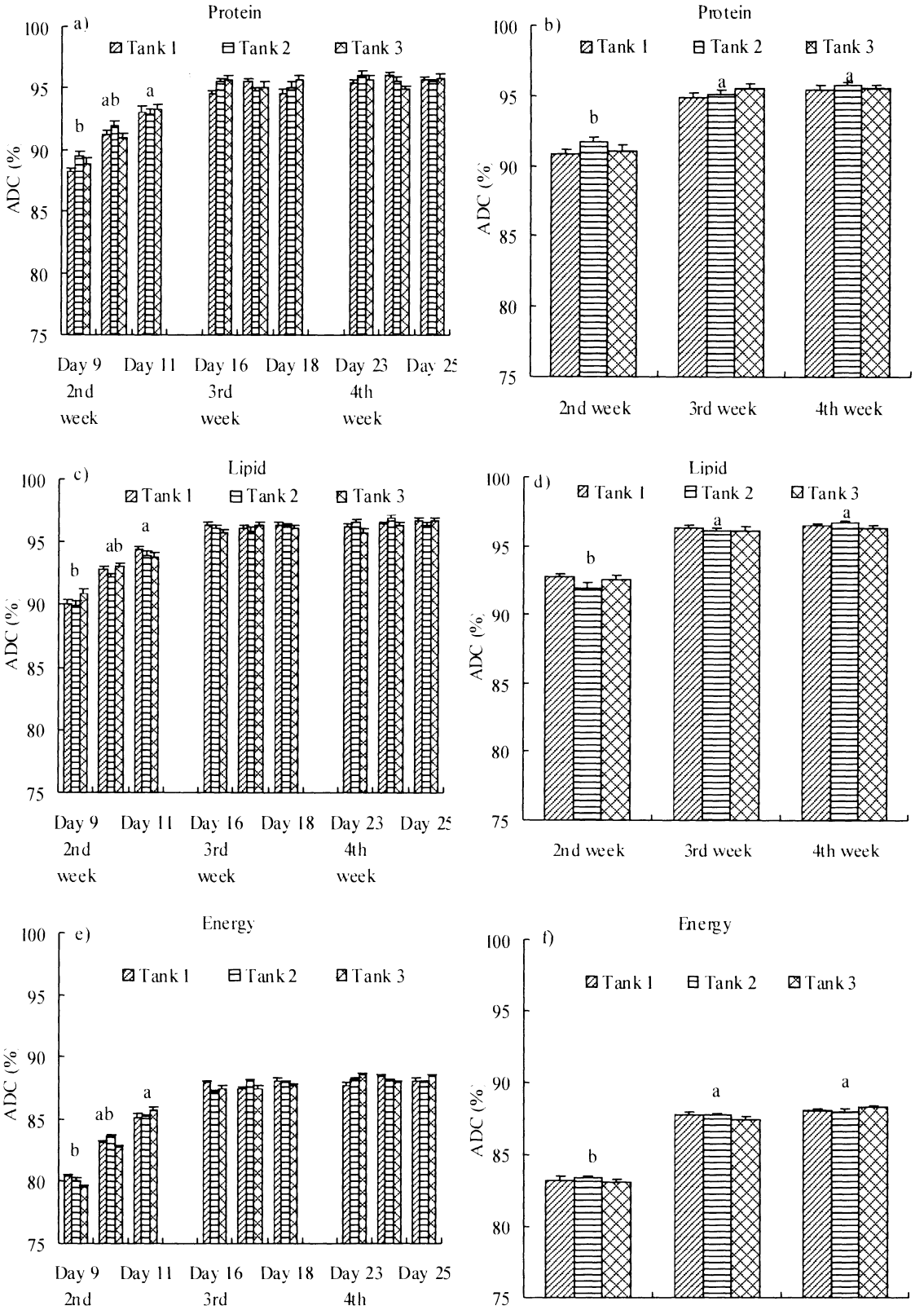

Fig. 1 Variation in the apparent digestibility coefficient of protein (a, b), lipid (c, d) and energy (e, f) among the replicates on different days and during the course of the study.

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