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K. Guo, I. Zoccarato, L. Gasco & G.B. Palmegiano

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K. Guo[1], I. Zoccarato[1], L. Gasco[1], G.B. Palmegiano[2]

[1] Dipartimento Scienze Zootecniche, Università di Torino, Italy
[2] Istituto Scienze delle Produzioni Alimentari, CNR, Grugliasco, Italy

Corresponding author: Kaijun Guo. Dipartimento Scienze Zootecniche. Via L. da Vinci 44, 10095 Grugliasco, Torino, Italy – Tel: +39 011 6708568 – Fax: +39 0116708563 – Email: guo.kaijun@unito.it

RIASSUNTO – Stima del rilascio d'azoto nell'allevamento della trota iridea (*Oncorhynchus mykiss*): proposta di un modello dinamico. *E' stato sviluppato un modello dinamico per la stima del rilascio d'azoto nell'allevamento della trota iridea. I risultati di 2 prove sperimentali sono stati utilizzati per la convalida del modello. Le analisi dei dati mostrano che il modello è affidabile per la stima del peso vivo, del rilascio d'azoto effettivo e di quello massimo. Il modello dinamico può essere utile per gli allevatori e le autorità di controllo delle acque per stimare il peso vivo dei pesci ed il rilascio d'azoto nell'ambiente per il mantenimento dello sviluppo sostenibile della produzione della trota iridea.*

Key words: dynamic model, nitrogen release, rainbow trout farming.

INTRODUCTION – In recent years, many countries have tried to decrease the nitrogen (N) excretion from animal production for its potential damage to the environment. Fish farming is an important N letting-off sector and should reduce its nitrogen (N) loads while maintaining optimal production. In fish farming production, N waste consists of excretory products and N-containing in faecal products. Research has been done focusing on the water output quality and total ammonia nitrogen (TAN) (Cheng *et al.* 2003). Several models have been developed to study the N output from fish farming (Frier *et al.*, 1995; Doglioli *et al.*, 2004). However, these researches cannot indicate the exact amount of N release from fish farming because of the various aquaculture wastes (dissolved nutrients, faecal matter and feed wastes) and the complicated chemical changes of ammonia after excretion. According to the principle that N release is the difference between N allotted to fish and N retention in the body, a dynamic model was developed using Stella® software package to predict N release (all form

of N wastes, including N in faecal matter, excretion products and uneaten feed) in rainbow trout production

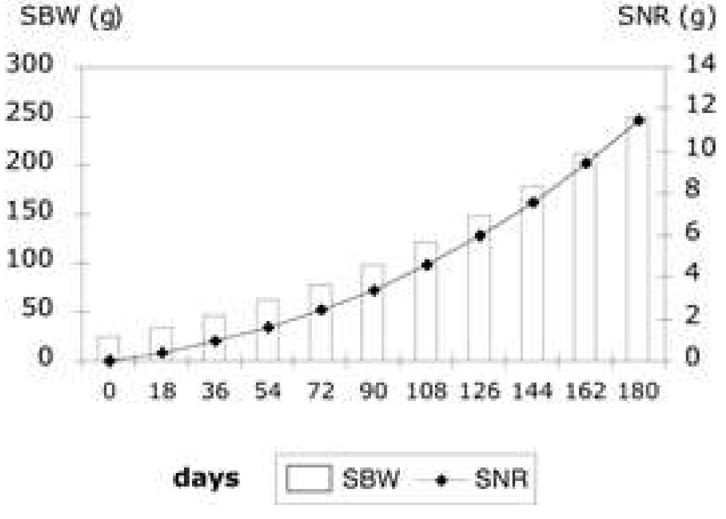
Successively the datasets of two experimental trials were used to verify the suitability of the model.

MATERIALS AND METHODS – To estimate N release in rainbow trout farming, 6 steps has been set up. In step 1, the stock represents actual body weight (ABW) based on the sum of initial body weight (IBW) and accumulation of body weight gain (BWG) expressed as an average value of either the whole period or different periods of trial (ABW = IBW + ΔBWG). In step 2, Daily Maximum Feed Intake (DMFI, f=1, where f is feeding level) can be estimated as $l_1 exp(l_3 T) w$^(l_4) [l_1 is 3.900E-2±(0.0021/0.0020); l_3 is 0.0759±0.0092; l_4 is 0.7246±0.0316 (values and 95% confidence limits given for each value were from Rasmussen and From, 1991]; Daily Maximum N Intake (DMNI) is calculated by multiplying DMFI with N content in the daily diet, which was usually determined in advance. In step 3, Daily Actual N Intake (DANI) is the multiplication of feed allotted to fish daily and N co tent in the daily diet. Step 4 simulates Daily Body Weight (SBW) using TGC with temperature, final and initia body weight (FBW and IBW) as inputs. (SBW = [$IBW^{1/3}$ + ∑(TGC * temp(°C)*days)]$^{1/3}$, where TGC = ($FBW^{1/3}$– $IBW^{1/3}$)/∑(temp(°C)*days), Cho, 1992). In step 5, N retention in the body (NR) is the difference between N conten in ABW and IBW. Here N content is set as 3.03% (determined by laboratory analysis). At last, in step 6, Dail Actual N Release (DANR) or Daily Maximum N Release (DMNR) is obtained using the difference between DANI/DMNI and NR. Actual N Release (ANR) and Maximum N Release (MNR) are stocks of DANR and DMNR respectively (ANR = ΔDANR; MNR = ΔMANR).

The model's inputs are IBW, FBW or daily BWG, feed consumption and its N content (if available). The outputs are Daily Simulated Biomass Weight (SBW), DANR and ANR or DMNR and MNR. To verify the model, the inputs and results of 2 trial datasets carried out in order to evaluate different meal timing, feeding level and type of feed (T1, Zoccarato *et al.*, 1991; T2, Zoccarato *et al.*, 1996) were employed. The differences among ANR and MNR between two trials were statistically analysed with ANOVA and GLM of SPSS 9.0. The regression between feeding level (f) and ratio between ANR and SNR (RNR) was analysed with regression analysis of SPSS.

RESULTS AND CONCLUSIONS – Using IBW and FBW as parameters, TGC was calculated for each group. Simulated Body Weight (SBW) were obtained using the dynamic model and compared with ABW. The linear relationship between SBW and ABW is SBW=0.9906*ABW (R^2=0.9548), which shows SBW can be used to simulate ABW when ABW is unknown.

In the two trials, the groups have no significant differences for FBW with similar IBW. ANR and MNR did not show significant differences between different groups and trials when the values were analysed considering duration of trial and feeding level as covariants, which means that the dynamic model can be used to estimate ANR and MNR for different feeding regimes (see table 1). As regards to single group T1, fed at 9 a.m., had a similar ANR with T1 fed at 4 p.m., while fish fed with 1.8% of BW had greater ANR than fish fed with 1.4% of BW. In T2, feeding level at satiation had more ANR than the restricted feeding level, especially for the group of T2 pellet to satiety. These results indicated that it is necessary to consider the feeding level and the environmental



impact in rainbow trout production in order to guarantee a sustainable production and high quality products.

To study the difference between ANR and MNR, feeding level (f) is calculated as ratio of AFI and MFI. The ratio (RNR) between ANR and MNR and f were calculated for every period of the two trials. The relationship between RNR and f can be easily estimated using a linear model RNR = 1.2559 f – 0.2645 (R^2=0.935). ANR can be estimated using MNR and f.

Table 1. ANR and MNR in the two trials

Treatment	IBW	FBW	Duration	Protein	TGC	f	ANR	MNR