STATISTICAL INTERPRETATION OF THE HATCHING PERCENTAGE OF CARP EGGS

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THE qualitative assessment of carp eggs obtained from natural collection, bundh breeding and induced breeding techniques[1-3] is important while planning strategies of fish seed production. The percentage of fertilization is determined from the number of good eggs in the random samples[3]. From these values hatchlings available for rearing can be estimated. Deviations in the predicted estimates of hatchlings have been a major problem in fish seed production management. Hence, a statistical approach is attempted to analyse and interpret the variability and suggest steps to overcome the difficulties experienced in the qualitative assessment of carp eggs

The Indian major carp of the region, mrigal (*Cirrhinus mrigala* Hamilton) was chosen for study. Eggs obtained by induced breeding from healthy and fully spent fishes, during the peak period of breeding season were utilized for the study. Good quality eggs of different developmental stages viz fertilization cone stage, 2-celled stage, morula stage, yolk plug stage, elongation stage and twitching stage were selected. The eggs, 100 in number in each case, were introduced into 2 l glass containers. Optimum hatching conditions were provided by continuous flow of water. The physico-chemical parameters were maintained constantly and uniformly. The number of hatchlings obtained from each set was noted and the percentage of good eggs was calculated. The experiment was repeated 5 times.

The mean and standard deviation at each stage were calculated and are presented in figure 1. As a relative index of variations, the coefficient of variation (CV) was worked out in each case (figure 1). The hatching percentage (percentage of good eggs) at different stages was compared using variance analysis technique. However, before analysis the percentages were first transformed into angles using angular transformation,

$$P = \sin^2 \theta,$$

where P is the percentage expressed as probabilities and θ the corresponding angles. The results showed significant differences between the stages. Hence, pairwise comparison using student's t test was made between the stages. The results are presented in a matrix diagram (figure 1), a new representation.

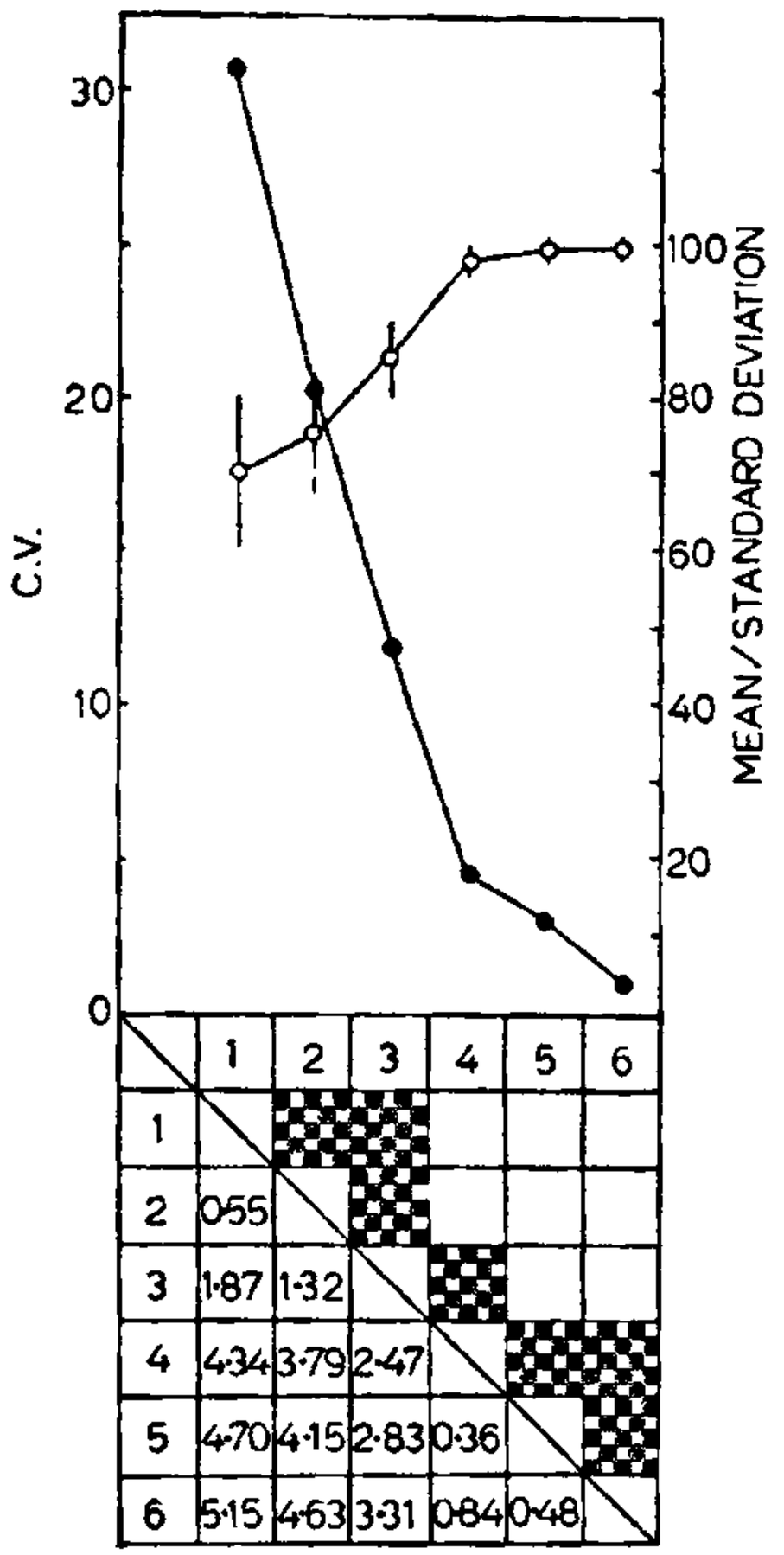

Figure 1. Matrix diagram showing pairwise comparisons (column vs. row; pattern denotes no significant difference) of different stages of carp eggs, fertilization cone (1), 2-celled stage (2), morula stage (3), yolk plug stage (4), elongation stage (5), and twitching stage (6), coefficient of variation,—CV (●——●); mean (○——○); vertical lines, standard deviation.

Scrutiny of the data shows that the CV, ranged between 0.4481 and 30.5371%. Interestingly it was below 0.9071% for stages above the yolk plug stage. Statistically significant difference was noticed in the ANOVA test, and pairwise comparison revealed that the three advanced stages, yolk plug stage, elongation stage and twitching stage were significantly different from the earlier stages, fertilization cone stage, 2-celled stage and morula stage. Only

between the morula and yolk plug stage was the difference not significant. Further, within these 3 advanced stages *t* was not significant at 5% level. In other words, yolk plug stage is the earliest which could be selected for determining the percentage of fertilization and estimates of hatchlings showing minimum variation. From the biological point of view, it was found that irregular cell division and whitening of eggs are more frequent in the earlier stages and once the yolk plug stage is attained, the probability of hatching is high. The yolk plug stage may be reasonably selected for qualitative assessments considering the practical necessity to assess at the earliest.

The matrix diagram (figure 1) is a new approach in presenting the results of pairwise comparisons most effectively. Using distinct patterns, significant differences at different levels can also be presented compactly. Inferences can be drawn more efficiently. One half of the diagonal can be used to present *t* values or other statistics used, if required. Another advantage is that the graph giving related statistics, in this case, mean standard deviations and CV can also be incorporated in the matrix diagram, rendering biological interpretation easier.

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NEUROENDOCRINE INVOLVEMENT IN THE REGULATION OF LACTATE AND SUCCINATE DEHYDROGENASE ACTIVITIES IN THE FRESHWATER CRAB, *BARYTELPHUSA GUERINI* (H. MILNE EDWARDS) (DECAPODA, POTAMIDEA)

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THE oxidative enzymes are intimately concerned with oxygen consumption and oxidation of metabolites. The neuroendocrine control of respiratory metabolism and oxidative enzymes in crustaceans is now an accepted fact although the effects of eyestalk ablation and eyestalk extract injection vary in different animals[1–9]. Also, the probable means by which the variations in respiration are brought about by the eyestalk hormone is not worked out clearly. As such, more studies on regulation of the activities of oxidative enzymes by the eyestalk hormone are needed for understanding the mechanism of neuroendocrine regulation of respiratory metabolism.

An earlier study on the crab, *Barytelphusa guerini* recorded that the respiratory metabolism declines on eyestalk ablation and is restored to the normal levels by the injections of eyestalk extracts[5]. In view of this, alterations in lactate and succinate dehydrogenase activities in relation to eyestalk ablation and eyestalk extract injections are analysed to assess the possible mechanism of neuroendocrine involvement in the regulation of respiratory metabolism in this animal. Collection maintenance, choice of animals, bilateral eyestalk ablation and eyestalk extract injections were carried out according to the procedure described earlier[5].

Succinate dehydrogenase (E. C. 1. 3. 99. 1) and lactate dehydrogenase (E. C. 1. 1. 1. 27) activities were estimated quantitatively in the muscle, gill, heart and hepatopancreas tissues in (i) the normal animals with intact eyestalks, (ii) in the eyestalk ablated animals, and (iii) in the eyestalk ablated but eyestalk extract injected animals. Eyestalk ablated animals were maintained for 48 hr and divided into 2 batches. One batch was used for enzyme assay,