Genetic Moddelling with Laboratory Animals

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Contributions of laboratory animals to livestock breeding research have been reviewed by Chapman(1961), Roberts(1965), Falconer(1966), and Bell(1974) and thus no supplementary comment would be needed of their values. At present, a considerable number of scientific papers on animal breeding research dealing with laboratory animals has been published every year.

Nevertheless, there seem to have some confusions among scientists with respect to the interpretation of genetic modelling. There are two distinct attitudes of mind. The first one refers very broad category in which any genetical experimentation dealing with inheritance in laboratory animals,i.e., Mendelian inheritance, sex-linkage, physiological, biochemical and molecular basis of genetics, polygenic variation, polymorghisms, induced mutations, chromosomal rearrangement, etc., are included. Those researches are very broad in nature and sometimes not immediately applicable to animal breeding, even though those may be very important in the long run. On the contrary, the second one refers rather restricted category in which experimental check of quantitative and population genetic theories including parameter estimations, effectiveness of selection, efficiencies of different breeding methods, test of new selection methods under different conditions, etc., are main subjects for research. In other words, the second attitude confines the genetic model to quantitative genetics in laboratory animals in which the conclusions from the experiments can be applied to animal breeding either directly or indirectly. The experiment is undertaken as a pilot experiment to solve a particular problem in animal breeding.

In the field of medical science, genetic model is often referred to a particular strain of laboratory animals which manifest a characteristic disorder genetically resembling to a disease in man. Obese model with mice(Festing, 1979) and hypertension model with rats(Yamori, 1977) are the examples. It would be more appropriate to classify these as "animal models of a certain disease" rather than "genetic model with laboratory animals".

I have been confined myself the definition of the genetic model with laboratory animsl rather strictly to the second attitude. Almost all of our experimentations with Drosophila and Tribolium were undertaken as pilot experiments of animal and poultry breeding.

According to the second definition of genetic model with laboratory animals, an experimental research to study the genetic architecture or make up of various characters of a laboratory animal itself is nothing to do with the genetic modelling, unless such a study was conducted as a part of selection experiment. Estimation of heritabilities and genetic correlations of various chracteristics in mice are a quantitative genetic study of the animal and thus we do not call it a genetic model. On the contrary, if the experiment is designed in such a way that the precision of parameter estimation is tested, the experiment is a genetic model.

Whether or not the experiment is called genetic model depends upon if the experimenter is intended to extraporate the findings to animal and poultry breeding.

As for the characters of laboratory animals, none of those are comparable to those of livestock. Egg production and egg weight in Drosophila and Tribolium are not comparable to those in chickens. Physiological mechanisms for manifesting these characters are entirely different between laboratory insects and chickens. However, genetic study on these traits in insects are quite appropriate to compare the trend of changes in these traits by different selection methods, if these traits are taken as the representatives of two traits with different heritability levels.

Bristle number in Drosophila, pupa weight in Tribolium, and 6-week body weight in mice have been extensively studied for many years and thus the genetics of the characters are well understood . Therefore, it is quite appropriate to study the effectiveness of index selection to improve two traits simultaneously, using either Drosophila or mice as genetic model.

On the other hand, the use of laboratory animals as a biological simulation to seek a better breeding scheme for predominantly additive and non-additive traits has been undertaken by several authors. Nevertheless, I have a doubt of the adequacy of such study. The reason is that the genetic architectures of these traits in insects are not comparable to the traits of farm animals and thus the inference derived from a labolatory animal will not be applicable to farm animals and poultry. Egg production and egg weight in Drosophila and Tribolium, were often regarded as comparable to those in chickens, and 6-week weight in mice was simulated market weight of pigs. It seems however to be very dangerous to extraporate the conclusions obtained in laboratory animals directly to animal breeding, although such assumptions that a mouse is more similar to a cow or pig than is a Drosophila in the way that the mouse gestates and suckles its young are acceptable.

To test a quantitative genetic theory, rather than to check the validity of the theory with laboratory animals, a computer simulation would be better. Because to test the theory all assumptions underlying a genetic model must be fulfilled. As far as the assumptions are satisfied, such theories must be correct. To test the theory with laboratory animals is therefore equivallent to look what assumptions are really violated in the laboratory animal. Answers to the discrepancy are often very unsatisfactory. If we could find a cause of the discrepancy, next is to built a better mathematical model from which the cause of discrepancy was deleted. This certainly reflects to improve the mathematical model to fit the laboratory animal but it does not guarantee better fit to the livestock in question.

There are ample data collected from laboratory animals and measurements were taken on various traits under different conditions. Such will be continued as ever. But it is very unlikely that each study would bring new information to solve the problems. We have so many repetions which gave us similar information but problems remains to be solved. To get rid of such repetitive experimentations more careful review of literatures and more frequent communication must be encouraged.

Primary objectives of genetic modelling with laboratory animals are to learn quickly the problems which will emerge during the course of selection and study how to cope with the complicated situation. It must be emphasized that genetic modelling with laboratory animals is a technique which is used in supporting of breeding research. The usefulness of genetic model constructed without associated breeding experimentation must be limited. Likewise, the effectiveness of selection program can enhanced tremendously if mating, selection and interpretation of the results are supported by genetical model with laboratory animals.

I would like to ask all of us to reconsider the genetic modelling with laboratory animals, if we will convince our tax payers that they will willingly support our breeding research with Drosophila, Tribolium or mice in addition to the research in livestock.

SUMMARY

Reviewing the papers presented to this Symposium, I have noticed a big discrepancy among scintists of the philosophy and interpretation of the Symposium title , which emerged since last Congress. Nearly half of the cases took their attitude referring the model closely asociated with animal breeding or evolution, while another half refered the genetical study in laboratory animals. I should emphasize that the interpretation of genetic model in this Congress should be confined to those which were undertaken to solve the problems of animal breeding rather than genetics of laboratory animsls.

RESUMEN

Revisando los trabajos presentados a este Symposium hemos tenido noticias de una gran discrepancia entre diversos hombres de ciencia sobre la filosofia y la interpretación del título del Symposium, el cual procede del último Congreso. Casi en la mitad de los casos la atención se ha referido a los modelos cerradamente asociados con la mejora animal o con la evolución, mientras que la otra mitad se refiere al estudio genético en animales de laboratorio. Deberia precisar que la interpretación del modelo genético en este Congreso deberia confinarse a aquellos que han pretendido resolver los problemas de mejora animal mejor que de genética de los animales de laboratorio.

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