PRELIMINARY STUDIES ON SIMULATION MODELS FOR DETERMINING PROTEIN REQUIREMENTS OF WEANLING AND GROWING PIGS IN TEMPERATE AND TROPICAL ENVIRONMENTS.

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ABSTRACT

Data on protein requirements of two weight categories of pigs, 4 - 9kg and 4 - 28kg, reared under temperate and tropical environments were obtained. These data were used to predict the protein requirement of pigs at different ambient temperatures. Models Y1 = 156.21 + 0.20(A) + 0.79(t) and Y_2 = 190.25 - 1.115(I) + 0.202(t) were derived respectively for animals weighing from 4-9kg and from 4 - 28kg. When these models were simulated using the SIMPTEST 1 simulation program, animals in the tropics weighing from 4 - 9kg were predicted to require 15.80g kg^{-1} or 11.11% of protein more than their temperate counterparts. Those weighing from 4-28kg in the tropics were predicted to require 4.04g kg^{-1} or about 2.0% more of protein than their corresponding counterparts reared under temperate climatic conditions.

Keywords: Simulation models, protein requirements, pigs, environments.

INTRODUCTION

High enviromental temperatures have negative effects on animal performance, especially in pigs (Fuller, 1965; Close and Stainer, 1985). In this specie a significant interation between ambient heat and level of feeding (and therefore nutrient intake) affects the growth performance (McCraken, 1973; Close *et al.,* 1978 Lopez *et al.,* 1994). Growing pigs housed in environments above and below their zone of thermoneutrality can be aided or conversely, stressed further by the dietary ingredients (Coffey *et al.* 1982 Crenshaw, 1995). Evidence in literature suggest that protein levels for both weaned and growing pigs are certainly higher in tropical regions than the recommendations emanating from temperate countries (Babatunde *et al.,* 1972; Iyayi, 1993). Perhaps the most significant reason is that of the relatively poor quality of the protein concentrates used in the tropics. Furthermore, if tropical pigs must derive their minimum daily requirements of protein from a relatively lower volume of feed intake than pigs reared in a temperate environment, then such diets must of necessity be higher in protein content to compensate for the low volume of feed intake. However, there is no information in literature stating specifically by how much pigs under temperate and tropical conditions differ in their protein requirements. This study was therefore designed to provide this information using the SIMPTEST 1 simulation program (Justus-Liebig Universitat, 1993).

MATERIALS AND METHODS

Sixty-five (65) experimental data on the protein requirements of weaners (4 - 9kg) and growing pigs (4 - 28kg) reared under temperate and tropical conditions were pooled from literature Thirty-three data and thirty-two data from temperate and tropical regions respectively were used. All reported experimental data used were on Landrace x Large white, between the years 1972 and 1992. The studies were those reported from the tropical regions of Africa, South America and Asia and from the temperate regions of Europe. For the weaners, the corresponding average daily gain (A) and average prevailing environmental temperature ($t^{o}C$) were recorded and used to derive a regression model with protein requirement as the dependent variable. For the growing pigs the respective average initial weights, (I), the average environment temperature al ($T^{o}C$)

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TABLE 1: PROTEIN REQUIREMENT OF PIGS (4 - 9KG) GAINING 200 - 800g d^{-1} AT DIFFERENT TEMPERATURES.

	Temperature (°C)						
	5	10	15	20	25	30	35
Average daily gain(g)							
200	167.16	171.10	175.06	179.01	182.96	186.91	190.86
300	169.16	173.11	177.06	181.01	184.96	188.91	192.86
400	171.16	175.11	179.06	183.01	186.96	190.91	194.86
500	173.16	177.11	181.06	185.01	188.86	192.91	196.86
600	175.16	179.11	183.06	187.01	190.96	194.91	198.86
700	177.16	181.11	185.06	189.01	192.96	196.91	200.86
800	179.16	183.11	187.06	191.01	194.96	198.91	202.86

TABLE 2: PROTEIN REQUIREMENT OF PIGS (4 - 28kg) AT DIFFERENT TEMPERATURES

	Temperature (°C)						
	5	10	15	20	25	30	35
Average initial weight (g)							
4	186.80	187.81	188.82	189.83	190.84	191.85	192.86
8	182.34	183.35	184.36	185.37	186.38	187.39	188.40
12	177.88	178.89	179.90	180.91	181.92	182.82	184.94
16	173.42	174.43	175.44	176.45	177.46	178.47	179.48
20	168.95	169.96	170.97	171.98	172.99	173.00	175.01
24	164.49	165.50	166.51	167.52	168.53	169.54	170.55
28	160.03	161.04	162.05	163.06	164.07	165.08	166.06

and average daily gain (A) were also recorded and the first two used to derive a regression model with the two factors acting as the variable ones and protein requirement as the dependent one. In both studies, the SPSS programme was used to run the regression analysis using the SPSAREGR. OVL and SPSDLREG. OVL modules within the programme. Thereafter, the regression models obtained were simulated using the SIMPTEST 1 simulation program (Justus-Liebig Universitat, 1993).

RESULTS AND DISCUSSION

Weaners (4 - 9kg)

The average daily gain (A) was negatively ($r = -0.60$) and significantly ($P < 0.01$) correlated with the environmental temperature. The regression model derived from associating protein requirement with average daily gain and temperature was:

$Y_1 = 159.21 + 0.20(A) + 0.79(t)$ where

Y_1 = protein requirement in g kg^{-1}

A = average daily weight gain in g

t = temperature in °C.

when this model was then simulated with the SIMPTEST 1 program, the result of predicted protein requirement of weaners meant to gain between 200g and 800gd-1 are as shown in Table 1.

Growing Pigs (4 - 28kg)

The average daily weight gain (A) was negative ($r = -0.5$) and significantly ($P < 0.01$) correlated to temperature but positively ($r = 0.4$) and significantly ($P < 0.05$) correlated to the initial weights (I) of the animals. The model derived from associating protein requirement, initial weight and temperature was

$Y_2 = 190.25 - 1.11(i) + 0.20(t)$ where

Y_2 = protein requirement in g kg^{-1}

I = initial weight in g

t = temperature in °C.

Simulation of this regression model using the SIMPTEST 1 program gave predicted protein

requirments of pigs with initial weights of between 4kg to 28kg as shown in Table 2. The results in Table 1 showed an increase in protein requirement by about 4g kg^{-1} for every 5°C rise in temperature. Furthermore, for every 100g predicted increase in the average daily gain and at a particular temperature, the protein requirement increased by 2g kg^{-1}. The predicted protein requirement at an A of 500g for example under temperate conditions is between 173.16-181.06g kg^{-1}, at thermal neutrality 185.01-188.96 kg^{-1} and under tropical condition 192.91-196.86gkg^{-1}. The difference in the protein requirement of pigs in the two environments was found to be 15.80g kg-1 or 11.11% increase of tropical requirement over requirement in the temperate.

For animals weighing between 4-28kg, initially there was a general increase in protein requirement by about 1.01g kg-1 for every 5°C increase in temperature. Interestingly, with an increase in the initial weight of the animals the predicted protein requirement at a particular temperature decreased by about 4.46g kg-1. Pigs in the tropics were predicted to require 4.04g kg^{-1} of protein or about 2.0% more than pigs reared under temperate conditions (Table 2).

Our results on the predicted protein requirements confirm reports of influence of ambient temperature on protein requirement. The results illustrate the importance of diet-dependent heat increment in thermal regulation of pigs housed at a high ambient temperature. Apart from induced reduction in feed intake, high environmental temperature is also related to protein degradation (Christon, 1988). As earlier stated by Steinbach(1985), protein concentrations need to be increased by approximately two percentage units in the range between 25 and 30°C, or the protein quality to be improved by adding lysine and methionine. Thus results of the present study have been able to demostrate clearly that because of a variety of factors in tropical countries among which are the high environmental temperature and low quality feed there is the need to increase the protein requirement of weaning pigs in the tropics by about 11.11% over the requirement in the temperate. But with bigger animals, this difference is reduced to about 2%

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