

( )

\*

( // : // : )

)  
( / / / / ) ( )  
( )

.(P < / )

% .(P < / ) % %  
.(P < / )

.(P < / )  
( )

:

/  
.( /

.( ) ( ) .( )

.( ) )

( )

-

( )

( )

( )

( )

)

)

(

(

(.)

( b)

/ /

( )

( )

(mg/kg)

(mg/kg)

\*

\*

\*

\*

\*

\*

\*

..... :

/ /  
/ /  
( )

A.O.A.C.

( )

:( )

$$ME_n = ( / \times CP) + ( / \times EE) + ( / \times NFE)$$

$$ME_n = ( / \times CP) + ( / \times EE) + ( / \times NFE)$$

)

.( )

( / / / )  
( )

)

(

S<sub>1</sub>

UFFDA

(Na+K-Cl)

/ pH

( )

×

GLM SAS

/

SPSS

SAS

MSTAT-C

SAS

SAS

±

( )

(Proc NLN)

)

)

(

)

(

(

---

1. Kolmogorov-Smirnov  
2. Kruskal Wallis



(P< / )

(P< / )

(r= / ) /

r=

( : )		( )		( / / )		( )		
/ a	a /	/ a	/ b	/ b	/ b	/ b	/ b	
/ b	b /	/ b	/ a	/ a	/ a	/ a	/ a	
/ b	b /	/ b	/ a	/ a	/ a	/ a	/ a	
/	/	/	/	/	/	/	/	
								SEM
								(%)
/ a	a /	a /	b	/ b	/ b	/	/	
/ b	b /	b /	ab	/ ab	/ a	/	/	
/ b	b /	b /	a	/ a	/ a	/	/	
/ b	b /	b /	a	/ a	/ a	/	/	
/	/	/	/	/	/	/	/	
								SEM
/	/	/ a	/	/	/ c	/	/	
/	/	/ b	/	/	/ b	/	/	
/	/	/ b	/	/	/ b	/	/	
/	/	/ b	/	/	/ b	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/ c	/	/	/ a	/	/	
/	/	/	/	/	/	/	/	
								SEM

Standard error of mean S.E.M.=  $\sqrt{\text{MSE}(\text{mean square})} \div \sqrt{N}$  (number of replicate)

NRC

(

( )

( )

( )

( )

( )

( )

( )

(Na+K-Cl)

( )

)

((

)

NRC

( )

NRC) % / (

NRC) % /

NRC

(

/ /

( )

( )

( )

( b)

NDF

( )

( )

( )

( )

( b)

( )



..... :

..... / / / %  
( ) ( )

( )

( ) ( )  
( ) ( )

) (( )  
( )

( ) ( )

..... / / / ( )  
( ) ( )  
(P > / ) / /

( )

( )

( P > / )

( P > / )

## REFERENCES

1. Afifi, M., F.A. Maie, & A.M. Abdel-Maksoud. 1992. Salt stress in broiler chicks. 1. Report: effect of salt stress on some productive traits in broiler chicks. *Archive. Geflugelk.* (56)124-128.
2. Ammerman, C.B., D.H. Baker, & A.J. Lewis. 1995. Bioavailability of nutrients for animals' amino acids, minerals and vitamins. Academic press Inc.
3. A.O.A.C. 1990. Official method of analysis of the association of official analytical chemists. P.O.Box540. Benjamin, Franklin station Washington, D.C.
4. Augustine, P.C., & H.D. Danforth. 1999. Influence of betaine and salinomycin on intestinal absorption of methionine and glucose and on the ultrastructure of intestinal cells and parasite developmental stages in chicks infected with *Eimeria acervulina*. *Avian Diseases.* (43)89-9.
5. Campbell, R.G., D.J. Cadogan, W.C. Morley, R. Uusitalo, & E. Virtanen. 1995. Interrelationships between dietary methionine and betaine on the growth performance of pigs from 65 to 100 kg. *J. Anim. Sci.* 73 (Suppl. 1), 82 (Abstract).
6. Cohen, I., S. Hurwitz, & B. Arie. 1977. Acid-Base balance and sodium to chloride ration in diets of laying hens. *Poultry Science.* (53)378-383.
7. Eklund, M., E. Bauer, J. Wamatu, & R. Mosenthin. 2005a. Potential nutritional and physiological functions of betaine in livestock. *Nutrition research reviews.* (18)31-48.
8. Eklund, M., J. Wamatu, H.P. Piepho, M. Tafaj, & R. Mosenthin. 2005b. Dietary betaine increases ileal and fecal digestibilities of several nutrients in piglets. *Proc. Soc. Nutr. Physiol.* (14)79.
9. Esteve-Garcia, E., & S. Mack. 2000. The effect of DL-methionine and betaine on growth performance and carcass characteristics in broilers. *Animal Feed Science and Technology.* (87)85-93.

- .... :
10. Feng, J., & DY. Yu. 2001. Effect of betaine on growth performance and methyl transfer function in finisher pigs. *Chinese Journal of Animal Science*. (37)8-10.
  11. Garcia, M.N., G.M. Petsi, & R.I. Bakalli. 2000. Influence of dietary protein level on the broiler chicken's response to methionine and betaine supplements. *Poultry Science*. (79)1478-1484.
  12. Ghodratnema, A., H. Sayahzadeh, D. Qujeq, M. Askari Moghaddam. 2004. The effect of chemical factors in water (TDS and Salts) on performance of broiler chickens. *Proceedings of the 1<sup>st</sup> congress on Animal & Aquatic Sciences*. The University of Tehran. 338-340.
  13. Janssen, W. M. M. A., ed. 1989. *European table of energy values for poultry feedstuffs*. 3rd ed. Beekbergen. Netherlands: Spelderholt center for poultry research and information services.
  14. Kalimuthu, S., R. Kand. 1987. Water quality and chick growth. *Indian Journal of Poultry Science*. (16)15-21.
  15. Kermanshahi, H. 2001. Betaine replacement for DL-Methionine in the performance and carcass characteristics of broiler chicks. *Journal agricultural science and technology*. (3) 273-279.
  16. Kettunen, H., S. Peuranen, J. Apajalahti, H. Jatila, P. Nurminen, & M. Saarinen. 1999. Effect of betaine on the microbiology of the chicken gastrointestinal tract. Page 186. In *Proceeding of the 12th European Symposium of Veldhofen*, the Netherlands.
  17. Kettunen, H., S. Peuranen, & K. Tiihonen. 2001a. Betaine aids in the osmoregulation of duodenal epithelium of broiler chicks, and affects the movement of water across the small intestinal epithelium in vitro. *Comparative Biochemistry and Physiology*. (129A) 595-603.
  18. Kettunen, H., S. Peuranen, K. Tiihonen, & M. Saarinen. 2001b. Intestinal uptake of betaine in vitro and the distribution of methyl groups from betaine, choline, and methionine in body of broiler chicks. *Comparative Biochemistry and Physiology*. (128A) 269-278.
  19. Klasing, K.C., K.I. Adler, J.C. Remus, & C.C. Calvert. 2002. Dietary betaine increases intraepithelial lymphocytes in the duodenum of coccidian-infected chicks and increases functional properties of phagocytes. *Journal of Nutrition*. (132) 2274-2282.
  20. Maiorka, A., N. Magro, H. Bartles, A. Kessler, & J. Penz. 2004. Different sodium levels and electrolyte balances in Pre-starter diets for broilers. *Brazilian Journal of Poultry Science*. (6)143-146.
  21. Matthews, J.O., & L.L. Southern. 2000. The effect of dietary betaine in *Eimeria acervoline*-infected chicks. *Poultry Science*. (79) 60-65.
  22. Matthews, J.O., L.L. Southern, T.D. Binder, & M.A. Persica. 2001 a. Effects of betaine, pen space, and slaughter handling method on growth performance, carcass traits, and pork quality of finishing barrows. *Journal of Animal Science*. (79) 967-974.
  23. Matthews, J.O., L.L. Southern, A.D. Higbie, M.A. Persica, & T.D. Binder. 2001 b. Effects of betaine on growth, carcass characteristics, pork quality, and plasma metabolites in finishing pigs. *Journal of Animal Science*. (79)722-728.
  24. McDevitt, R. M., S. Mack & I. R. Wallis. 2000. Can betaine partially replace or enhance the effect of methionine by improving broiler growth and carcass characteristics? *Br. Poult. Sci.* (41)473-480.
  25. Mirsalimi, S.M., P. O'Brien, & R. Julian. 1992. Blood volume increase in salt-induced pulmonary Hypertension, heart failure and ascites in broiler and white leghorn chickens. *Can Journal of veterinary research*. (57)110-113.
  26. National Research Council. 1984. *Nutrient Requirements of Poultry*. 9th. ed. Natl. Acad. Press, Washington, DC.
  27. National Research Council. 1994. *Nutrient Requirements of Poultry*. 9th rev. ed. Natl. Acad. Press, Washington, DC.
  28. Overland, M., K.A. Rorvik, & A. Skrede. 1999. Effect of trimethylamine oxide and betaine in swine diets on growth performance, carcass characteristics, nutrient digestibility, and sensory quality of pork. *Journal of Animal Science*. (77)2143-2153.
  29. Puchala, R.T., M.J. Sahlu, J.J. Herselman, & S.P. Davis. 1995. Influence of betaine on blood metabolites of alpine and angora kids. *Small Ruminant Research*. (18)1376-143.

30. Puchala, R., R. Zabielski, P. Lesniewska, V. Gralak, P. Kiela, & W. Barej. 1998. Influence of duodenal infusion of betaine or choline on blood metabolites and duodenal electrical activity in Friesian calves. *Journal of Agricultural Science*. (131) 321-327.
31. Rhone-Poulenc. 1993. Rhodimet<sup>TM</sup> Nutrition guide. Rhone-Poulenc Animal Nutrition, Anatomy Cedex, France.
32. Robbins, K.R. 1986. A method, SAS program, and example for fitting broken line to growth data. The University of Tennessee agricultural experiment station, research report, 86-90.
33. ROSS, Broiler management manual. 2002. Aviagen limited, Newbridge, Midlothian EH28 8SZ, Scotland, UK.
34. SAS Institute Inc. 1996. SAS/STAT User's Guide: Version 6.4th edn. SAS Institute Inc., Cary, North Carolina.
35. Saunderson, C.L., & J. Mackinlay. 1990. Changes in body weight, composition and hepatic enzyme activities in response to dietary methionine, betaine and choline levels in growing chicks. *Br. J. Nutr.* (63) 339-349
36. Schutte, J.B., J. de Jong, W. Smink, & M. Pack. 1997. Replacement value of betaine for DL-methionine in male broiler chicks. *Poultry Science*. (76) 321-325.
37. Sklan, D., Y. Noy. 2000. Hydrolysis and absorption in the small intestines of post hatch chicks. *Poultry Science*. (79) 1306-1310.
38. Virtanen, E., J. McNaughton, L. Rosi, D. Hall. 1993. Effect of betaine supplementation on intestinal lesions, mortality and performance of coccidian-challenged broiler chick. In: *Proceedings of the 9th European Symposium on Poultry Nutrition*, Jelenia Gorda, Poland, pp. 433-435.
39. Virtanen, E., & L. Rosi. 1995. Effects of betaine on methionine requirement of broilers under various environmental conditions. In *Proceedings of the Australian Poultry Science Symposium*, Pages. 88-92. Sydney, NSW, Australia: University of Sydney.
40. Wang, Y. Z. 2000. Effect of betaine on growth performance and carcass traits of meat ducks. *J. Zhejiang Univ. Agric. Life Sci.* (26) 347-352.
41. Wang, Y.Z., Z.R. Xu, & M.L. Chen. 2000. Effect of betaine on carcass fat metabolism of meat duck. *Chinese Journal of Veterinary Science*. (20) 409-413.
42. Wiedmeier, R.D., B.H. Tanner, J.R. Bair, H.T. Shenton, M.J. Arambel, & J.L. Walters. 1992. Effects of a new molasses by-product, concentrated separator by-product, on nutrient digestibility and ruminal fermentation in cattle. *Journal of Animal Science*. (70) 1936-1940.