COMPENDIUM (RESEARCH PAPERS)

20th BIENNIAL INTERNATIONAL CONFERENCE OF ANIMAL NUTRITION SOCIETY OF INDIA ON
SUSTAINABLE ANIMAL NUTRITION FOR GLOBAL HEALTH AND PRODUCTION: INNOVATIONS AND DIRECTIONS

NABARD

20th BIENNIAL INTERNATIONAL CONFERENCE

OF

ANIMAL NUTRITION SOCIETY OF INDIA

ON

SUSTAINABLE ANIMAL NUTRITION FOR GLOBAL HEALTH AND PRODUCTION: INNOVATIONS AND DIRECTIONS

COMPENDIUM (RESEARCH PAPERS)

23rd to 25th January, 2024

Chief Editor
Dr. R. Karunakaran

Associate Editors
Dr. L. Radhakrishnan
Dr. P. Vasan
Pasupathi Karu
S. Gunasekaran
A. Ruba Nanthini
P. Anuradha

DEPARTMENT OF ANIMAL NUTRITION
MADRAS VETERINARY COLLEGE
TAMI... ND ANIMAL SCIENCES UNIVERSITY
...AI – 600 007, TAMIL NADU (INDIA)

20TH BIENNIAL INTERNATIONAL CONFERENCE
OF
ANIMAL NUTRITION SOCIETY OF INDIA
ON

SUSTAINABLE ANIMAL NUTRITION FOR GLOBAL HEALTH AND PRODUCTION: INNOVATIONS AND DIRECTIONS

COMPENDIUM (RESEARCH PAPERS)

23rd to 25th January, 2024

Chief Editor
Dr. R. Karunakaran

Associate Editors
Dr. L. Radhakrishnan
Dr. P. Vasan
Pasupathi Karu
S. Gunasekaran
A. Ruba Nanthini
P. Anuradha

DEPARTMENT OF ANIMAL NUTRITION
MADRAS VETERINARY COLLEGE
TAMIL NADU VETERINARY AND ANIMAL SCIENCES UNIVERSITY
CHENNAI – 600 007, TAMIL NADU (INDIA)

Title of the Book	:	20th BIENNIAL INTERNATIONAL CONFERENCE OF ANIMAL NUTRITION SOCIETY OF INDIA ON **SUSTAINABLE ANIMAL NUTRITION FOR GLOBAL HEALTH AND PRODUCTION: INNOVATIONS AND DIRECTIONS** COMPENDIUM (RESEARCH PAPERS)
Copy Right	:	ANSI & TANUVAS
Language	:	English
Paper Quality	:	70 gsm Maplitho paper Wrapper 300 gsm art board
Size of Book	:	A4 size
Pages	:	533
Price	:	Academic Purpose; NOT FOR SALE
Year of Publication	:	2024
ISBN	:	978-81-968649-9-6

CONCLUSION

It was concluded that the citric acid supplementation improved the weight gain, feed intake and FCR and decreased the faecal*E.coli* count in LWY pigs.

REFERENCES

Ritanarayanan, Ronald, B.S.M., Krishnakumar, N., Gopu, P., Bharathidasan, A and Prabhakaran, R. (2008). Effect of citric acid as feed additive in swine starter diet, *Indian Journal of Animal Research*, 42 (4): 308-309

Wolin, M. J. (1969). Volatile fatty acids and the inhibition of *Escherichia coli* growth by rumen fluid.*Applied Microbiology*, 17:83–87

Table 1.Effect of citric acid supplementation on fecal *E.coli* count of LWY pigs (Mean# ± S.E)

E. coli count of excreta	Citric acid (%)				
	0	0.5	1.0	1.5	2
Initial day	$8.62 \times 10^{11} \pm 0.14$	$8.42 \times 10^{11} \pm 0.27$	$8.42 \times 10^{11} \pm 0.24$	$8.58 \times 10^{11} \pm 0.15$	$8.50 \times 10^{11} \pm 0.18$
Middle week	$8.73 \times 10^{11} \pm 0.18^{d}$	$8.42 \times 10^{9} \pm 0.26^{c}$	$7.58 \times 10^{8} \pm 0.20^{b}$	$9.47 \times 10^{6} \pm 0.25^{a}$	$9.50 \times 10^{6} \pm 0.18^{a}$
Last week	$8.78 \times 10^{11} \pm 0.17^{d}$	$8.17 \times 10^{9} \pm 0.21^{c}$	$7.88 \times 10^{8} \pm 0.14^{b}$	$9.58 \times 10^{6} \pm 0.11^{a}$	$9.73 \times 10^{6} \pm 0.09^{a}$

#Mean of six observations; Means bearing different superscript in the same row differs significantly (p<0.01)

SEN_014

Influence of Chelated Microelements on Production Results and Histological Parameters of Weaned Piglets

Dejan Perić[1]*, Dragan Šefer, Roberto Barea, Stamen Radulović, Dragoljub Jovanović, Radmila Marković

University of Belgrade - Faculty of Veterinary medicine, Department of Animal Nutrition and Botany, Bulevar Oslobodjenja 18, 11000 Belgrade, Serbia;
**contact person e-mail: dperic@vet.bg.ac.rs*

Keywords: Microelements, chelated forms, production results, histological parameters.

The development of intensive pig production is a continuous process due to progress in the understanding of biochemical and physiological processes in pigs, as well as the improvement of production technology. Given that feed accounts for 60-70% of the total cost of pork production, the scientific and professional community is constantly working on adapting mixtures for piglets to the high and specific needs in nutrients of this category of animals. Due to the increasing demands of the global consumer lobby, and respecting the production priorities (better use of feed, longer sustainability, easier manipulation) with the ultimate goal of increasing production and improving the quality of food of animal origin, in addition to the basic nutrients, a large number of additives with different purposes are added to the mixtures (Šefer et al., 2014).

As one of the proposed strategies, the term "chelate" or "chelate complex" is introduced into the literature and practical use, which represents a complex compound in which a metal ion is bound to a ligand that possesses two or more donor atoms, whereby the ligand includes a metal ion such as " pincers" forming "rings". A ligand is a molecule or ion that contains an atom with a free electron pair that makes a bond with a metal ion. For example, any of the naturally occurring amino acids can be a ligand and form a stable fivemembered ring with a metal ion. The chemical process of complexation or chelation initially created confusion in the feed industry. Terms such as metal-amino acid "complexes", amino acid-metal "chelates", metal-polysaccharide "complexes", etc., are numerous, but their official definitions are unclear. Organically bound microelements are recognized as a bioavailable source of microelements that is more usable than their traditional inorganic analogues such as sulfates and oxides (To et al., 2021). Inorganic forms of microelements have been used for years primarily due to their favorable price and availability, however, in recent years, the so-called "chelated" forms, i.e. organically bound microelements, have been increasingly used.

Aim of the Research

The aim of the research was to investigate the justification and effects of the use of chelated forms of microelements (Cu, Mn, Zn) in the diet on the health status, production performance of piglets, as well as the histological characteristics of certain segments of the digestive tract of piglets.

Material and Methods

The experimental protocol was approved by the Veterinary Directorate of the Serbian Ministry of Agriculture, Forestry and Water Management and the Ethics Committee of the Faculty of Veterinary Medicine, University of Belgrade (Resolution number: 23/2020).

During the formation of the trial, an individual clinical examination of the chosen piglets was carried out, so that all the selected individuals were healthy, vital and in good condition. During the formation of experimental groups, all piglets were uniform in terms of origin, gender and body weight (± 10%). During the experiment, the health condition of the test subjects was monitored daily. The experiment was conducted on 48 decided piglets of the same origin, with an equal sex ratio. Piglets aged 28 ± 1 days were randomly assigned to two experimental groups (C and E-I). Each experimental group consisted of 6 subgroups (two male and two female individuals per subgroup). The experiment lasted 42 days and was divided into two phases. The first phase lasted from 0-21. days, and the second phase from 21-42. of the day. During the experiment, the health status and production results of the piglets were monitored. At the end of the experiment, on the 42nd day after the usual piglet slaughtering procedure, samples of individual intestinal segments were taken for the intended tests. From the beginning (28-day-old piglets) to the end (70-day-old piglets) of the experiment, experimental groups of animals were fed with complete mixtures of standard chemical and raw material composition, and the mixtures were formulated to meet the recommended nutrient requirements according to the NRC (National Research Council: Nutrient Requirements of Swine, 11th Edition, National Academies Press 2012, Washington DC).

Table 1. Ingredients and nutrient composition of basal diets

Item	Phase 1 (d 0 to d 21)	Phase 2 (d 21 to d 42)
Ingredients (%)		
Corn	45.00	57.00
Barley	10.00	10.00
Soybean meal	12.00	15.00
Full fat soya	23.00	14.00
Vitamin-mineral premix[a,b]	10.00	4.00
Total	100.00	100.00
Nutrient composition		
Metabolic energy (MJ/kg)[*]	13.74	13.78
Moisture (%)	10.50	11.50
Crude protein (%)	20.35	18.25
Crude fat (%)	6.95	5.60
Crude fiber (%)	4.04	3.66

Item	Phase 1 (d 0 to d 21)	Phase 2 (d 21 to d 42)
Ash	6.20	5.50
Calcium (%)	0.95	0.83
Total phosphorus (%)	0.68	0.63
Sodium (%)	0.19	0.18
Lysine (%)*	1.39	1.26
Methionine+cysteine (%)*	0.77	0.68
Threonine (%)*	0.81	0.75
Tryptophan (%)*	0.23	0.22

[a]Provided per kilogram of diet in phase 1 (d 0 to d 21): 20.000 IU vitamin A, 2.000 IU vitamin D_3, 80 mg vitamin E, 2.4 mg vitamin K_3, 2.4 mg vitamin B1, 6 mg vitamin B2, 6 mg vitamin B6, 0.4 mg vitamin B12, 0.3 mg biotin, 32 mg niacin, 14 mg Ca-pantothenate, 5 mg folic acid, 3 mg I, 0.4 mg Se, 0.6 mg Co, 550 mg choline chloride, 240 mg Fe, 130 mg Cu, 120mg Mn, 100 mg Zn, 1000 mg phytase, 100 mg antioksidant BHT.

*Calculated values.

Table 2. Study treatments

Treatment code	Inclusion of protected benzoic acid	Inclusion of chelated trace minerals[b]
Phase 1 (d 0 to d 21)		
C - control[a]	-	-
CTM (mineral methionine hydroxy analog chelate (Cu, Mn, Zn))	-	130 ppm Cu, 60 ppm Mn and 60 ppm Zn
Phase 2 (d 21 to d 42)		
Control	-	-
CTM (mineral methionine hydroxy analog chelate (Cu, Mn, Zn)	-	80 ppm Cu, 60 ppm Mn and 60 ppm Zn

[a]Trace minerals contents of control diet for the phase 1 were 130 ppm Cu as CuSO4, 120 ppm of Mn as MnSO4 and 100 ppm of Zn as ZnSO4, whereas for the phase 2 the trace minerals content were 80 ppm Cu as CuSO4, 120 ppm of Mn as MnSO4 and 100 ppm of Zn as ZnSO4. [b]Chelated trace minerals were added according to the "Reduce and Replace" concept (complete amount of inorganic Cu, Mn and Zn was replaced by the chelated form of the listed trace minerals)

Results

The health status of the individuals during the experiment was satisfactory and no signs of disease were disturbed. The experimental group of piglets that consumed feed with the addition of chelated forms of copper, manganese and zinc achieved better production results, achieving better growth, and also achieved better conversion, while consuming a smaller amount of feed per achieved unit of growth.

Table 3. Production results and parameters ($\bar{X} \pm Sd$) of control and experimental group of piglets

Fattening days	Parameters	Groups	
		C	E-1
1to 21	Average body gain (kg), n=6	5.97±1.24	6.38±1.30
	Average daily body gain (kg), n=6	0.28±0.06	0.30±0.06
	Feed consumption (kg), n=6	43.20±2.43	44.08±3.77
	Daily feed consumption (kg), n=6	0.51±0.03	0.52±0.05
	Feed conversion ratio, n=6	1.81[a]±0.03	1.73[a]±0.06

Fattening days	Parameters	Groups	
		C	E-1
21 to 42	Average body gain (kg), n=6	12.21[a]±2.33	13.36[a]±0.98
	Average daily body gain (kg), n=6	0.58[a]±0.11	0.64[a]±0.05
	Feed consumption (kg), n=6	101.80±9.05	103.70±1.80
	Daily feed consumption (kg), n=6	1.21±0.11	1.24±0.02
	Feed conversion ratio, n=6	2.09[A]±0.08	1.94[A]±0.04
1 to 42	Average body gain (kg), n=6	18.18[a]±3.19	19.74[a]±1.67
	Average daily body gain (kg), n=6	0.43±0.08	0.47±0.04
	Feed consumption (kg), n=6	145.00±11.71	147.80±4.10
	Daily feed consumption (kg), n=6	0.87±0.07	0.88±0.03
	Feed conversion ratio, n=6	2.00[A]±0.07	1.87[A]±0.04

Legend: Same letter in a raw [a]-$p<0.05$; [A]-$p<0.01$.

The results of the histological examinations of the control and experimental groups of piglets are shown in table 5. The experimental group of piglets achieved better values of the height of the intestinal villi and the depth of the intestinal crypts in most segments of the intestine, which is also shown through the ratio of these two parameters. In this way, a larger absorptive surface was achieved in the intestines of the experimental group of piglets.

Conclusion

Based on the obtained results, we can conclude that the use of chelated forms of copper, manganese and zinc in piglet nutrition has its own nutritional, medical and economic justification. By improving the histological parameters, the resorptive surface in the intestines increased, which led to better production performances of piglets.

Acknowledgement

The study was supported by the Ministry of Science,Technological Development and Innovation of the Republic of Serbia (Contract number 451-03-47/2023-01/200143).

Literature

1. Brown DC., Maxwell CV., Erf GF., Davis ME., Singh S., Johnson ZB. 2006. The influence of different management systems and age on intestinal morphology, immune cell numbers and mucin production from goblet cells in post-weaning pigs. *Vet Immunol Immunop*. 111:187–98.
2. Byrne L., Hynes JM., Connolly DC., Murphy AR. 2021. Influence of the Chelation Process on the Stability of Organic Trace Mineral Supplements Used in Animal Nutrition, Animals, 11, 1730.
3. Carlson MS., Boren CA., Wu C., Huntington CE., Bollinger DW., Veum TL. 2004. Evaluation of various inclusion rates of organic zinc either as polysaccharide or chelate complex on growth performance, plasma, and excretion in nursery pigs. J Anim Sci, 82:1359-1366.
4. Carlson MS., Hoover SL., Hill GM., Link JE., Turk JR. 1998. Effect of pharmacological zinc on intestinal metallothionein concentration and morphology in the nursery pig [abstract]. Journal of Animal Science 1998, 76:57.
5. Castillo M., Martín-Orúe SM., Taylor-Pickard JA., Pérez JF., Gasa J. 2008. Use of mannanoligosaccharides and zinc chelate as growth promoters and diarrhea preventative in weaning pigs: Effects on microbiota and gut function. J Anim Sci, 86:94-101.

6. Creech BL., Spears JW., Flowers WL., Hill GM., Lloyd KE., Armstrong TA., Engle TE. 2004.Effect of dietary trace mineral concentration and source (inorganic vs. chelated) on performance, mineral status, and fecal mineral excretion in pigs from weaning through finishing. J Anim Sci, 82:2140–2147.

7. Gao J., Yin J., Xu K., Li T., Yin Y. 2019. What Is the Impact of Diet on Nutritional Diarrhea Associated with Gut Microbiota in Weaning Piglets: A System Review. Biomed Res Int.2019:6916189.

8. Han XY., Ma YF., Lv MY., Wu ZP., Qian LC. 2014. Chitosan-zinc chelate improves intestinal structure and mucosal function and decreases apoptosis in ileal mucosal epithelial cells in weaned pigs. British Journal of Nutrition, 111:1405–1411.

9. LeDividich J., Sève B. 2000. Effects of underfeeding during the weaning period on growth metabolism, and hormonal adjustments in the piglet. Dom Anim Endocrinol, 19:63–74.

10. McLamb BL., Gibson AJ., Overman EL., Stahl C., Moeser AJ. 2013. Early weaning stress in pigs impairs innate mucosal immune responses to entero- toxigenic E. coli challenge and exacer- bates intestinal injury and clinical disease. PLoS ONE, 8:e59838.

11. Mullan BP., Hernandez A., Pluske JR. 2004, Influence of the form and rate of Cu and Zn supplementation on the performance of growing pigs [abstract]. Biotechnology in the Feed Industry, Nottingham University Press, Nottingham, UK.

12. National Research Council: Nutrient Requirements of Swine. 11th Edition, National Academies Press 2012. Washington DC.

13. Qi Z., Chen YG. 2015. Regulation of intestinal stem cell fate specification. *Sci China Life Sci*. 58:570–8.

14. Schiavon S., Bailoni L., Ramanzin M., Vincenzi R., Simonetto A., Bittante G. 2000. Effect of proteinate or sulfate mineral sources on trace elements in blood and liver of piglets. Anim. Sci. 71:131–139.

14. Šefer D., Grdović S., Marković R., Nedeljković-Trailović J., Petrujkić B., Radulović S. 2014. Primena biotehnologije u ishrani životinja, Zbornik radova i kratkih sadržaja 25.Savetovanja veterinara Srbije Zlatibor, 37-38.

15. To VPTH., Masagounder K., Loewen ME. 2021. Critical transporters of methionine and methionine hydroxy analogue supplements across the intestine: What we know so far and what can be learned to advance animal nutrition. *Comp. Biochem. Physiol. Part A Mol. Integr. Physiol.255*, 110908.

16. Veum TL., Bollinger DW., EllersieckMR. 1995.Proteinated trace mineral and condensed fish protein digestin weanling pigdiets.*J. Anim. Sci.73*, 308.

17. Wang J., Zeng L., Tan B., Li G., Huang B., Xiong X. 2016. Developmental changes in intercellular junctions and Kv channels in the intestine of piglets during the suckling and post-weaning periods. *J Anim Sci Biotech*. 7:1–10.

SEN_001

Apparent Digestibility of Nutrients in Pigs Fed with Varied Levels of Tamarind (*Tamarindus indica*) Seed KeRN_el

Girish, S., Suma, N.*, Sravani, P., Navyashree, G. and Satpute Pratibha Dharba
Department of Animal Nutrition, Veterinary College, KVAFSU, Bengaluru, KaRN_ataka, India
**Presenting author's email: sumavet@gmail.com*

Introduction

Swine farming is emerging as an effective enterprise for improving the socio-economic status of resource poor farmers in India by taking a shape of an industry. ICMR (2009) recommends minimum of 20 g out of 60 g daily protein requirement for human being from animal protein source and hence, there is an increase in