



### 不同铜源对育成期雌性银狐生长性能、营养物质消化率及血液生化指标的影响

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### Effects of Different Copper Sources on Growing Performance, Nutrient Digestibility and Blood Biochemical Parameters of Female Silver Foxes during Growth Period

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**摘要** 本试验旨在研究不同铜源对育成期雌性银狐生长性能、营养物质消化率以及血液生化指标的影响,以寻求育成期雌性银狐饲料中适宜铜源。试验选取40只平均体重为(3 315±11) g的健康雌性银狐,随机分成4组,每组10个重复,每个重复1只。各组银狐分别饲喂在基础饲料中添加甘氨酸螯合铜(I组)、蛋氨酸螯合铜(II组)、硫酸铜(III组)、柠檬酸铜(IV组)的试验饲料,各试验饲料中铜源的添加水平以铜计均为30 mg/kg。基础饲料中铜含量为5.47 mg/kg。预试期7 d,正试期45 d。结果表明:不同铜源对育成期雌性银狐的末重、平均日增重和料重比均有显著影响( $P<0.05$ ),对平均日采食量无显著影响( $P>0.05$ )。IV组的末重和平均日增重显著高于III组( $P<0.05$ ),IV组的料重比显著低于II组( $P<0.05$ )。不同铜源对育成期雌性银狐的干物质、蛋白质和脂肪的消化率无显著影响( $P>0.05$ )。血清总蛋白、尿素氮、免疫球蛋白G、免疫球蛋白M、铜蓝蛋白含量及碱性磷酸酶活性各组间差异不显著( $P>0.05$ ),但IV组尿素氮含量和碱性磷酸酶活性均略高于其他组。不同铜源对育成期雌性银狐的血清白蛋白含量、超氧化物歧化酶活性有显著影响( $P<0.05$ ),对血清铜锌超氧化物歧化酶活性有极显著影响( $P<0.01$ )。IV组血清白蛋白含量显著高于其他各组( $P<0.05$ ),I组血清超氧化物歧化酶活性显著高于II和III组( $P<0.05$ ),I和III组血清铜锌超氧化物歧化酶活性极显著高于II组( $P<0.01$ )。本试验条件下,综合考虑生长性能、营养物质消化率及血液生化指标,得出育成期雌性银狐饲料适宜铜源为柠檬酸铜。

**关键词:** 铜源 雌性银狐 生长性能 营养物质消化率 血液生化指标

**Abstract:** This experiment was conducted to study the effects of different copper sources on growth performance, nutrient digestibility and blood biochemical parameters of female silver foxes during growth period, and in order to investigate the optimal copper source for the diet of female silver foxes during growth period. Forty female silver foxes with an average body weight of (3 315±11) g were selected and randomly assigned into 4 groups with 10 replicates per group and 1 silver fox per replicate. The silver foxes in the 4 groups were fed the basal diets supplemented with different copper sources, which were glycine chelate copper (group I), methionine chelate copper (group II), copper sulfate (group III) and citric acid copper (group IV), respectively. The copper level in the basal diet was 5.47 mg/kg, and the copper supplemental level of all experimental diets was 30 mg/kg (counted with copper). The experiment included an adaptation period for 7 days and a test period for 45 days. The results showed as follows: different copper sources had significant effects on final weight, average daily gain (ADG) and feed to gain ratio (F/G) ( $P<0.05$ ), but had no significant effect on average daily feed intake (ADFI) ( $P>0.05$ ). The final weight and ADG in the group IV were significantly higher than those in the group III ( $P<0.05$ ), and the F/G in the group IV was significantly lower than that in the group II ( $P<0.05$ ). Different copper sources had no significant effect on digestibility of dry matter, protein and fat ( $P<0.05$ ). There were no significant differences in serum total protein (TP), urea nitrogen (UN), immunoglobulin G (IgG), immunoglobulin M (IgM), ceruloplasmin (CP) contents and alkaline phosphatase (ALP) activity among all groups ( $P>0.05$ ), but the UN content and ALP activity in the group IV were all higher than those in the other groups. Different copper sources had significant effects on serum albumin (ALB) content and superoxide dismutase (SOD) activity ( $P<0.05$ ), and had a extremely significant effect on serum Cu/Zn-SOD activity ( $P<0.01$ ). The serum ALB content in the group IV was significantly higher than that in the other groups ( $P<0.05$ ), the serum SOD activity in the group I was significantly higher than that in the groups II and III ( $P<0.05$ ), and Cu/Zn-SOD in the groups I and III was extremely significantly higher than that in the group II

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( $P < 0.05$ ). Under this study conditions, on the basis of comprehensive consideration of the growth performance, nutrient digestibility and blood biochemical parameters, the optimal dietary copper source is citric acid copper for female silver foxes during growth period.

Keywords: copper source, female silver fox, growth performance, nutrient digestibility, blood biochemical parameter

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- [1] 吴建设, 冯于明, 杨汉春, 等. 微量元素铜的营养与免疫研究进展[J]. 国外畜牧科技, 1999, 26(1): 5-9.
- [2] CROMWELL G L, STAHLY T S, MONEGUE H J. Effects of source and level of copper on performance and liver copper stores in weanling pigs [J]. Journal of Animal Science, 1989, 67: 2996-3002.
- [3] STANSBURY W F, TRIBBLE L F, ORRJR D E, Jr. Effect of chelated copper sources on performance of nursery and growing pigs[J]. Journal of Animal Science, 1990, 68: 1318-1322.
- [4] 王希春, 吴金节, 李义刚, 等. 高铜对断奶仔猪生长性能及血清激素水平的影响[J]. 动物医学进展, 2005, 26(8): 63-67.
- [5] 高凤仙, 杨仁斌, 何河, 等. 不同铜源及其水平对猪生产性能和血液生化指标的影响[J]. 湖南农业大学学报: 自然科学版, 2007, 33(5): 595-598.
- [6] COFFEY R D, COFFEY G L, MONEGUE H J. Efficacy of a copper-lysine complex as a growth promotant for weanling pigs[J]. Journal of Animal Science, 1994, 72(11): 2880-2886.
- [7] ZHOU W, KORNEGAY E T, LINDEMANN M D, et al. Stimulation of growth by intravenous injection of copper in weanling pigs[J]. Journal of Animal Science, 1994, 72(9): 2395-2403.
- [8] BAKALLI R I, PESTI G M. Dietary copper in excess of nutritional requirement reduces plasma and breast muscle cholesterol of chickens[J]. Food Science, 1995, 74: 360-365.
- [9] 甘伯中. 不同铜添加水平对毛兔生产性能、消化代谢、组织器官和血液成分的影响[D]. 硕士学位论文. 兰州: 甘肃农业大学, 2000: 24-25.
- [10] 李道林. 铜源和铜水平对生长獭兔的生长性能、毛皮品质及理化指标的影响[D]. 硕士学位论文. 长春: 中国人民解放军军需大学, 2002: 2-3.
- [11] 白玉妍, 张浩, 叶纯子, 等. 蛋氨酸铜、蛋氨酸锌对乌苏里貉冬毛生长长期体重及毛皮质量的影响[J]. 黑龙江畜牧兽医, 2009(7): 113-114.
- [12] AULERICH R J, RINGER R K. Feeding copper sulfate. Could it have benefits in nutrition of mink?[J]. U.S. Fur Rancher, 1976, 56(12): 4-9.
- [13] BUSH C R, RESTUM J C, BURSIA S J, et al. Responses of growing mink to supplemental dietary copper and biotin[J]. Scientifur, 1995, 19(2): 147.
- [14] AULERICH R J, RINGER R K, BLEAVINS M R, et al. Effects of supplemental dietary copper on growth, reproductive performance and kit survival Standard dark mink and the acute toxicity of copper to mink[J]. Journal of Animal Science, 1982, 55(2): 337-343.
- [15] MEJBORN H. Effect of copper addition to mink feed during the growth and moulting period on growth, skin production and copper retention [J]. Scientifur, 1989, 13(3): 229-234.
- [16] 李光玉, 王凯英, 赵靖波. 毛皮动物矿物元素的需要[J]. 经济动物学报, 2003, 7(4): 10-13.
- [17] 吴学壮, 张铁涛, 崔虎, 等. 饲料添加铜水平对育成期水貂生长性能、营养物质消化率及氮代谢的影响[J]. 动物营养学报, 2012, 24(6): 1078-1084.
- [18] 朱广祥, 范克平. 饲料生产应用手册[M]. 北京: 中国农业科技出版社, 1997.
- [19] DOVE C R. The effect of copper level on nutrient utilization of weanling pigs[J]. Journal of Animal Science, 1995, 73(1): 166-171.
- [20] 李家奎, 郑鑫, 杨连玉, 等. 不同形态的铜对猪生长性能及血清GH、血浆NPY水平的影响[J]. 中国兽医学报, 2004, 24(5): 488-503.
- [21] 黄志坚, 陈强, 李清禄, 等. 不同形态铜源对仔猪生长性能、血液生化指标和粪铜排出量的影响[J]. 家畜生态学报, 2007, 28(1): 32-35.
- [22] 齐广海, 武书庚, 刁其玉, 等. 不同铜源及水平的日粮对产蛋鸡生产性能及蛋品质的影响[J]. 动物科学与动物医学, 2000, 17(6): 14-16.
- [23] 刘国文, 王哲. 促生长激素轴与铜促生长的关系[J]. 动物医学进展, 2000, 21(3): 22-24.
- [24] BRAUDE R. Copper as a stimulant in pig feeding (*Cuprum propecunia*) [J]. World Review of Animal Production, 1967, 3: 69-81.
- [25] WALLACE H D. High level copper in swine feeding[M]. New York: International Copper Research Association, Inc., 1967.
- [26] LUO X G, DOVE C R. Effect of dietary copper and fat on nutrient utilization, digestive enzyme activities, and tissue mineral levels in weanling [J]. Journal of Animal Science, 1996, 74: 1888-1896.

- [27] 冷向军,王康宁.高铜对早期断奶仔猪消化酶活性、营养物质消化率和肠道微生物的影响[J].饲料研究,2001(4):28-30.
- [28] PAU K Y F,KHORRAM O,KYNARD A H,et al.Simultaneous induction of neuropeptide Y and gonadotropin-releasing hormone release in the rat hypothalamus[J].Neuroendocrinology,1989,49:197-201.
- [29] 李秀宝,张恒博,黄郁萱,等.营养水平对保育期美系长白猪血清生化指标的影响[J].畜牧与兽医,2010,42(7):21-25.
- [30] 余红心,贾俊静,李琦华,等.不同蛋白质水平日粮对云南武定鸡生长性能及血液生化指标的影响[J].中国饲料,2009(5):24-26.
- [31] 张苏江.日粮铜水平对生长猪生长性能及生化指标影响的研究[D].硕士学位论文.长春:中国人民解放军军需大学,2001:26-27.
- [32] 程忠刚,许梓荣,林映才,等.高剂量铜对仔猪生长性能及血液生化指标的影响[J].动物营养学报,2004,16(4):44-46.
- [33] 伍革民,柳小春,施启顺,等.血浆酶活性与猪生产性状及其杂种优势的相关研究[J].甘肃畜牧兽医,1999(1):34-36.
- [34] 杨文正.动物矿物质营养[M].北京:中国农业出版社,1996:65-87.
- [35] HAWK S N,LANOUE L,KEEN C L,et al.Copper-deficient rat embryos are characterized by low super oxide dismutase activity and elevated superoxide anions[J].Biology of Reproduction,2003,68(3):896-903.
- [1] 徐晨晨,王宝维,葛文华,张名爱,岳斌,史雪萍.铜对5~16周龄五龙鹅生长性能、屠宰性能、营养物质利用率和血清激素含量的影响[J].动物营养学报,2013,25(9):1989-1997
- [2] 张世忠,王全溪,王长康,吴南洋,江斌,邵良平.丁氨丙磷溶液对肉仔鸡生长性能和免疫功能的影响[J].动物营养学报,2013,25(9):2111-2117
- [3] 张铁涛,崔虎,高秀华,杨福合,李光玉,邢秀梅.低蛋白质饲料中添加蛋氨酸对育成期蓝狐生长性能和营养物质消化代谢的影响[J].动物营养学报,2013,25(9):2036-2043
- 黄学琴,任周正,曾秋凤,张克英,丁雪梅,白世平,罗玉衡,刘永刚.液态复合酶制剂对肉鸭生长性能及钙、磷代谢的影响[J].动物营养学报,2013,25(9):2044-2049