动物营养学报 » 2011, Vol. 23 » Issue (09) :1545-1552 DOI: 10.3969/j.issn.1006-267x.2011.09.013

锌和降钙素基因相关肽对仔猪摄食的影响及其机制研究

（浙江大学动物科学学院，动物分子营养学教育部重点实验室，杭州310029）

Zinc and CGRP on Feed Intake of Piglets: Effects and Mechanism

（Key laboratory for molecular animal nutrition of ministry of education, College of Animal Science, Zhejiang University, Hangzhou 310029,China）

摘要 本试验旨在研究锌和降钙素基因相关肽（CGRP）对仔猪摄食的影响及其机制。试验选用30头9.57 kg左右的“杜×长×大”三元杂交仔猪，随机分为5组（对照Ⅰ组、试验Ⅰ组、对照Ⅱ组、试验Ⅱ组和试验Ⅲ组），每组6头猪。5组均饲喂相同的基础饲粮，饲养试验期14 d。禁食24 h后，对照Ⅰ组、试验Ⅰ组和试验Ⅱ组分别注射0、2和4 mg/kg BW的锌，注射24 h后屠宰；对照Ⅱ组和试验Ⅲ组分别注射0和0.05 mg/kg BW的CGRP，注射2 h后屠宰。结果表明：1）与对照Ⅰ组相比，试验Ⅰ组采食量显著提高（P<0.05），试验Ⅱ组采食量却显著降低（P<0.05）；与对照Ⅱ组相比，试验Ⅲ组采食量显著下降（P<0.05）。2）注射锌对仔猪血糖和瘦素水平无显著性影响（P>0.05），而使甘油三酯（TG）、胰岛素和胰高血糖素水平显著降低（P<0.05）；注射CGRP显著降低血糖、TG、胰岛素水平（P<0.05），显著提高胰高血糖素水平（P<0.05），而对瘦素水平无显著性影响（P>0.05）。3）与对照Ⅰ组相比，试验Ⅰ组和试验Ⅱ组神经肽Y（NPY）mRNA表达量显著提高（P<0.05），CGRP mRNA表达量和胆囊收缩素（CCK）mRNA表达量显著降低（P<0.05）；与对照Ⅱ组相比，试验Ⅲ组NPY mRNA表达量显著降低（P<0.05），CGRP mRNA表达量和CCK mRNA表达量显著提高（P<0.05）。由此可知，一定剂量的锌可通过调节胰岛素和胰高血糖素分泌，诱导食欲神经肽NPY mRNA表达，抑制饱腹神经肽CGRP和CCK mRNA表达，促进仔猪采食。CGRP可通过促进胰高血糖素分泌，抑制食欲神经肽NPY mRNA表达，诱导饱腹神经肽CGRP和CCK mRNA表达，抑制仔猪采食。

关键词： 锌 CGRP 仔猪 采食量

Abstract： This experiment was conducted to study the effects of zinc and calcitonin gene-related peptide (CGRP) on feed intake and its regulation mechanism of piglets. Thirty crossed-bred (Duroc×Landrace×Large White) pigs with an average body weight of 9.57 kg were randomly assigned to five groups (control group Ⅰ, trial group Ⅰ, trial group Ⅱ, control group Ⅱ and trial group Ⅲ) with 6 piglets per group. Piglets in all the groups were fed with the same basal diet. The feeding trial lasted for 14 days. After 24-hour fasting (free access to water), piglets in control group Ⅰ, trial group Ⅰ and trial group Ⅱ were injected 0, 2 and 4 mg/kg BW zinc, and then slaughtered at 24-hour after injection. Piglets in control group Ⅱ and trial group Ⅲ were injected 0 and 0.05 mg/kg BW CGRP, and then slaughtered at 2-hour after injection. The results showed as follows: 1) compared with the control group Ⅰ, feed intake of trial group Ⅰ and trial group Ⅱ were significantly increased (P<0.05) and decreased (P<0.05), respectively. Compared with the control group Ⅱ, feed intake in trial group Ⅲ were significantly decreased (P<0.05). 2) There were no significant differences on serum glucose and leptin levels by injection of zinc （P>0.05）, but the triglyceride (TG), insulin and glucagon levels were significantly decreased (P<0.05). Injection of CGRP significantly decreased serum glucose, TG and insulin levels (P<0.05) and increased glucagon levels (P<0.05), but had no effect on leptin levels （P>0.05）. 3) Compared with the control group Ⅰ, the expression levels of NPY mRNA in trial group Ⅰ and trial group Ⅱ were significantly increased (P<0.05), but the CGRP and CCK mRNA expression levels were significantly decreased (P<0.05). Compared with the control group Ⅱ, the CGRP and CCK mRNA expression level were significantly increased (P<0.05), while NPY mRNA expression levels was decreased significantly (P<0.05) in trial group Ⅲ. These results indicate that zinc can stimulate intake of piglets through inducing NPY mRNA expression and inhibiting CGRP and CCK mRNA expression. However, CGRP can compromise feed intake of piglets by inhibiting NPY mRNA expression and inducing CGRP as well as CCK mRNA expression. [Chinese Journal of Animal Nutrition, 2011, 23（9）: 1545 -1552]

Keywords： zinc， CGRP， piglets， feed intake

基金资助:

国家自然科学基金锌调控仔猪摄食行为的分子机制研究（30771571/C020302）

通讯作者 钱利纯，副研究员，硕士生导师，E-mail: lcqian@zju.edu.cn

作者简介: 王坤坤（1986—），女，山东滨州人，硕士研究生，研究方向为动物营养与饲料科学。E-mail: wk3424@126.com

引用本文:

. 锌和降钙素基因相关肽对仔猪摄食的影响及其机制研究[J]. 动物营养学报, 2011,V23(09): 1545-1552

. Zinc and CGRP on Feed Intake of Piglets: Effects and Mechanism[J]. Chinese Journal of Animal Nutrition, 2011,V23(09): 1545-1552.

链接本文:

http://211.154.163.124/Jweb_dwyy/CN/10.3969/j.issn.1006-267x.2011.09.013 **或**
http://211.154.163.124/Jweb_dwyy/CN/Y2011/V23/I09/1545

[1] DREOSTI I E. Review: zinc and the gene[J]. Mutation Research, 2001, 475:161-167.

[2] BRAND-NETO J, STEFAN V, MENDONCA B B, et al. The essential role of zinc in growth[J]. Nutrition Research, 1995, 15(3):335-358.

[3] SUN J Y, JING M Y, FU L J, et al. Effects of dietary zinc levels on the activities of enzymes, weights of organs and the concentrations of zinc and copper in growing rats[J]. Biological Trace Element Research, 2005, 107(2):153-165.

[4] RAINS T M, HEDRICK S, RANDALL A C, et al. Food intake patterns are altered during long-term zinc deficiency in rats[J]. Physiology and Behavior, 1998, 65(3): 473-478.

[5] MACDONALD R S. The role of zinc in growth and cell proliferation[J]. The Journal of Nutrition, 2000, 130(5):15005-15085.

[6] 许梓荣，王敏奇.高剂量锌促进猪生长机理探讨[J].畜牧兽医学报,2001,32(1):11-17.

[7] SUN J Y, JING M Y, WANG J F, et al. Effect of zinc biochemical parameters and changes in related gene expression assessed by cDNA microarrays in pituitary of growing rats[J]. Nutrition, 2006, 22(2):187-196.

[8] SCHELL T C, KORNEGAY E T. Effectiveness of zinc acetate injection in alleviating postweaning performance lag in pigs[J]. Journal of Animal Science, 1994, 72:3037-3042.

[9] JING M Y, SUN J Y, WANG J F. The effect of peripheral administration of zinc on food intake in rats fed Zn-adequate or Zn-deficient diets[J]. Biological Trace Element Research, 2008, 124:144-156.

[10] SUN J Y, JING M Y, WANG J F, et al. The approach to the mechanism of calcitonin gene-related peptide-inducing inhibition of food intake[J]. Journal of Animal Physiology and Animal Nutrition, 2010, 94(5):552-560.

[11] HAHN J D, BAKER D H. Growth and plasma zinc responses of young pigs fed pharmacologic level of zinc[J]. Journal of Animal Science, 1993, 71:3020-3024.

[12] MORLEY J E, FARR S U, FLOOD J F. Peripherally administered calcitonin gene-related peptide decreases food intake in mice[J]. Peptides, 1996, 17(3): 511-516.

[13] DHILLO W S, SMALL C J, JETHWA P H, et al. Paraventricular nucleus administration of calcitonin gene-related peptide inhibits food intake and stimulates the hypothalamo-pituitary-adrenal axis[J]. Endocrinology, 2003, 144(4):1420-1425.

[14] KRAHN D D, GOSNELL B A, LEVINE A S. Effect of calcitonin gene-related peptide on food intake[J]. Peptides, 1984, 5(5):861-864.

[15] GEROZISSIS K. Brain insulin and feeding: a bi-directional communication[J]. European Journal of Pharmacology, 2004, 490:59-70.

[16] 萧黎,莫宝庆,陈新峰.肥胖儿童食欲与瘦素胰岛素水平的关系[J].中国学校卫生,2008,29(12):1127-1129.

[17] 高鑫.胰岛素在中枢神经对控制摄食与体质量平衡的作用[J].第二军医大学学报,2003,24(5):298-300.

[18] HOLLOWAY S A, STEVENSON J A. Effect of glucagon on food intake and weight gain in the young rat[J]. Canadian Journal of Physiology and Pharmacology, 1964, 42:867-869.

[19] FURUSE M, MATSUMOTO M, OKUMURA J, et al. Intracerebroventricular injection of mammalian and chicken glucagon-like peptide-1 inhibits food intake of the neonatal chick[J]. Brain Research, 1997, 755(1):167-169.

[20] LUHESHI G N, GARDNER J D, RUSHFORTH D A, et al. Leptin actions on food intake and body temperature are mediated by IL-1[J]. Neurobiology, 1999, 96:7047-7052.

[21] WANG Z W, ZHOU Y T, KAKUMA T, et al. Comparing the hypothalamic and extrahypothalamic actions of endogenous hyperleptinemia [C]//Proceedings of the National Academy of Science of the United States of America. Washington D.C.: National Academy of Sciences, 1999, 96(18):10373-10378.

[22] HILLEBRAND J J, DE WIED D, ADAN R A. Neuropeptides, food intake and body weight regulation: a hypothalamic focus[J]. Peptides, 2002, 23 (12):2283-2306.

[23] KALRA P S. KALRA S P. Use of antisense oligodeoxynucleotides to study the physiological functions of neuropeptide Y[J]. Methods, 2000, 22

(3):249-254.

[24] LEE R G, RAINS T M, TOVAR-PALACIO C, et al. Zinc deficiency increases hypothalamic neuropeptide Y and neuropeptide Y mRNA level and does not block neuropeptide Y-induced feeding in rats[J]. The Journal of Nutrition, 1998, 128(7):1218-1223.

[25] DHILLO W S, SMALL C J, JETHWA P H, et al. Paraventricular nucleus administration of calcitonin gene-related peptide inhibits food intake and stimulates the hypothalamo-pituitary-adrenal axis[J]. Endocrinology, 2003, 144(4):1420-1425.

[26] 舒鼎铭,谭健萍,曹永长.缩胆囊素（CCK）的生物学功能研究进展[J].饲料工业,2004,25(11):12-16.

[1] 刘忠臣,陈代文,余冰,吕美,毛湘冰,韩国全,陈洪,毛倩.**不同脂肪来源对断奶仔猪生长性能和脂类代谢的影响**[J]. 动物营养学报, 2011,23(09): 1466-1474

[2] 陈渝,陈代文,毛湘冰,毛倩,齐莎日娜,余冰.**精氨酸对免疫应激仔猪肠道组织Toll样受体基因表达的影响**[J]. 动物营养学报, 2011,23(09): 1527-1535

[3] 侯振平,印遇龙,王文杰,刘景喜,SOUFFRANT W B.**乳铁蛋白素B和天蚕素P1对投喂大肠杆菌断奶仔猪生长及肠道微生物区系的影响**[J]. 动物营养学报, 2011,23(09): 1536-1544

[4] 蒋义,贾刚,黄兰,吴彩梅,王康宁 .**不同水平精氨酸-甘氨酸-谷氨酰胺对断奶仔猪空肠体外酶活及细胞增殖与凋亡的影响**[J]. 动物营养学报, 2011,23(09): 1475-1482

[5] 张董燕,季海峰,王晶,王四新,刘辉,单达聪,刘苹苹,王雅民.**猪源罗伊氏乳酸杆菌对断奶仔猪生长性能和血清指标的影响**[J]. 动物营养学报, 2011,23(09): 1553-1559

[6] 吴睿,张敏红,冯京海,郑姗姗.**日循环高温对肉鸡组织锌离子浓度及金属硫蛋白含量的影响**[J]. 动物营养学报, 2011,23(08): 1273-1279

[7] 陈俊材,王威,王之盛.**利用体外法研究纳米氧化锌的添加对瘤胃发酵的影响**[J]. 动物营养学报, 2011,23(08): 1415-1421

[8] 王改英,吴在富,杨维仁,胥保华.**饲粮蛋白质水平对意大利蜜蜂咽下腺发育及产浆量的影响**[J]. 动物营养学报, 2011,23(07): 1147-1152

[9] 王晓翠,王浩,李杰.**发酵豆粕在断奶仔猪生产中的应用研究**[J]. 动物营养学报, 2011,23(06): 919-923

[10] 洪宇,刘玉兰,吴志锋,朱惠玲,侯永清,丁斌鹰.**鱼油对仔猪生产性能、炎性介质和下丘脑-垂体-肾上腺轴激素的影响**[J]. 动物营养学报, 2011,23(06): 937-942

[11] 张帅,刘婷婷,周琳,陈安国,洪奇华,杨彩梅.**断奶仔猪小肠钠葡萄糖转运蛋白1和葡萄糖转运蛋白2 mRNA表达变化及饲粮添加谷氨酰胺对其的影响**[J]. 动物营养学报, 2011,23(06): 983-990

[12] 刘婷婷,张帅,邓斐月,曹广添,陈安国,杨彩梅.**谷氨酰胺与丁酸梭菌对断奶仔猪生长性能、免疫功能、小肠形态和肠道菌群的影响**[J]. 动物营养学报, 2011,23(06): 998-1005

[13] 徐敏云,谢帆,李运起,李建国,伊霞,曹玉凤.**施肥对青贮玉米营养品质和饲用价值的影响**[J]. 动物营养学报, 2011,23(06): 1043-1051

[14] 周怿，刁其玉，屠焰，云强.**酵母β-葡聚糖和杆菌肽锌对早期断奶犊牛生长性能和胃肠道发育的影响**[J]. 动物营养学报, 2011,23(05): 813-820

[15] 黄琳，蒋宗勇，林映才，周桂莲，郑春田，陈芳.**饲喂氧化鱼油对新生仔猪肠道黏膜免疫应答的影响及大豆异黄酮的干预作用**[J]. 动物营养学报, 2011,23(05): 799-806