



Q K 2 2 5 8 0 8 9

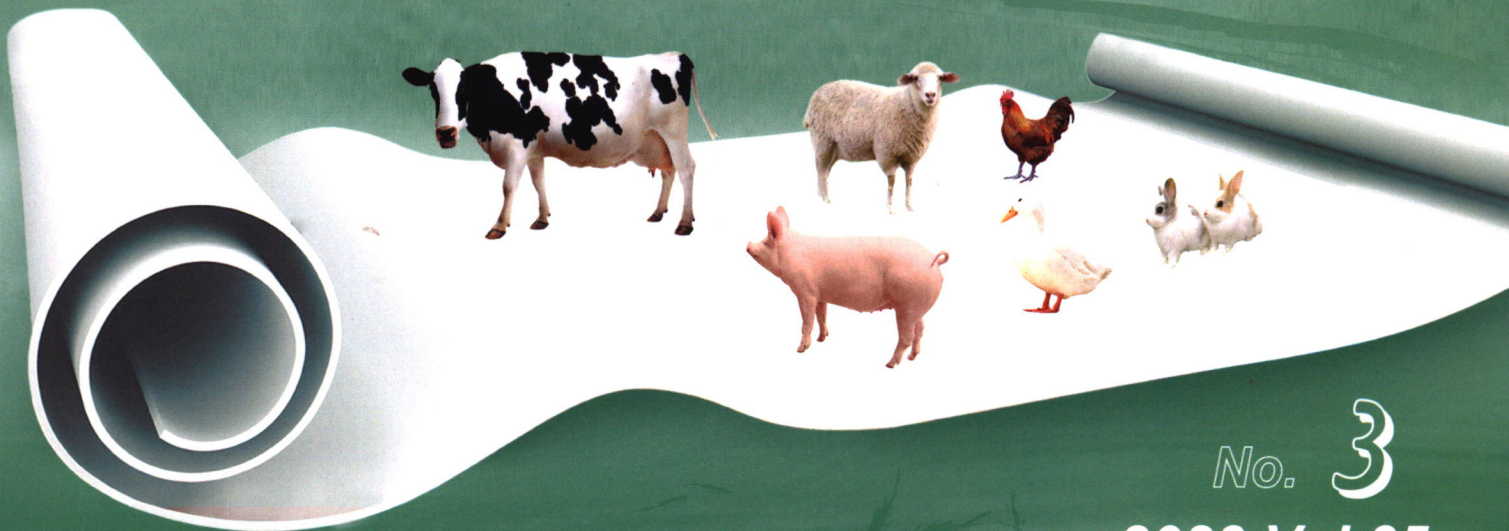
ISSN 1006-267X

CN 11-5461/S

# 动物营养学报

CHINESE JOURNAL OF ANIMAL NUTRITION

[www.ChinaJAN.com](http://www.ChinaJAN.com)



No. 3

2023 Vol.35

中国畜牧兽医学会

CHINESE ASSOCIATION OF ANIMAL SCIENCE AND VETERINARY MEDICINE

万方数据



# 动物营养学报

DONGWU YINGYANG XUEBAO

百种中国杰出学术期刊 期刊数字影响力 100 强(学术类期刊)  
中国精品科技期刊 中国科学引文数据库(CSCD)核心库来源期刊 中国科技核心期刊  
中文核心期刊 中国科学评价研究中心权威期刊(A<sup>+</sup>级) 荷兰 Scopus 收录期刊  
英国 CAB Abstracts 收录期刊 美国 Chemical Abstracts 收录期刊

第 35 卷 第 3 期 2023 年 3 月

## 目次

### 综述

|                                              |                                         |
|----------------------------------------------|-----------------------------------------|
| 1361 植物性成分与犬肠道健康的研究进展                        | 张 鹏 王思源 李俞甫<br>Короткова Ирина Павловна |
| 1368 短链脂肪酸在肠脑轴中的作用                           | 杨 雪 高亚男 王加启 郑 楠                         |
| 1380 饲喂频率对猪采食量及氮素利用影响的研究进展                   | 付 鑫 张琦玉 秦贵信 赵 元                         |
| 1387 细胞因子在猪胚胎附植期的作用及机制                       | 潘旭静 常俊磊 吴 德 徐盛玉                         |
| 1396 阴离子型饲料预防奶牛产乳热的机制及其应用进展                  | 袁 静 李胜利 王 硕 王 蔚                         |
| 1405 猫饮食的营养结构管理与慢性肾病的关系研究进展                  | 贾汇真 张安荣 武振龙 杨 鹰                         |
| 1413 槲皮素基于内质网应激信号通路调节动物机体健康和疾病的研究进展          | 梅华迪 陈秋雨 马现永 余 苗                         |
| 1426 沉默信息调节因子 2 相关酶 1 对乳脂、乳蛋白合成和乳腺炎的调节及其可能机制 | 曹佩佩 冀思同 窦文丽 马燕芬                         |
| 1433 饲用豆粕减量替代技术的应用及新型蛋白质饲料的开发前景              | 高鹏翔 潘予琮 蒋林树 方洛云                         |
| 1444 黄酮类化合物对动物胃肠道健康调控作用的研究进展                 | 李兰柱 胡红莲 高 民 孙满吉                         |
| 1454 原花青素通过塑造肠道菌群调节免疫应答的作用与机制研究进展            | 苏玲玲 黎小银 易宏波 高彦华                         |
| 1468 广藿香的生物学功能及其在畜牧生产中的应用                    | 康黎波 李 翌 邓宏达 宋小珍                         |
| 1475 生物性添加剂在青贮饲料中的研究进展                       | 易启轩 王 鹏                                 |

### 研究论文

|                                             |                                               |
|---------------------------------------------|-----------------------------------------------|
| 1489 低蛋白质饲料中添加发酵菜籽粕对育肥猪生长性能和肉品质的影响          | 顾 方 刘世龙 李红胜 倪冬娇<br>王 丽 徐晓明 吴善森 靳振豪<br>杨雪芬 蒋宗勇 |
| 1501 仔猪小肠优势乳酸杆菌断奶前后全肠道演替及其比较代谢组学研究          | 刘洙言 郝友玲 宋庆庆 陈 辉<br>孙士强 李 菊 武振龙 戴兆来            |
| 1513 脂多糖刺激后不同时间点断奶仔猪肠道中凋亡和自噬信号通路的动态变化       | 秦 旭 周墨涵 尉心田 陈少魁<br>刘玉兰 肖 勘                    |
| 1520 益生菌对肠道损伤条件下断奶仔猪生长性能影响的 Meta 分析         | 高靖春 曹舒婷 姚 康 黄凯勇<br>李耀杰 何振涛 展宪亮 蒋宗勇<br>王 丽     |
| 1532 灵芝粉对地方蛋鸡生产性能、蛋品质、免疫功能和抗氧化能力的影响         | 牛晋国 张希瑶 申李琰 张 旗<br>叶红心 李培峰 李亚妮                |
| 1540 四逆散加葛根混合物对产蛋后期蛋鸡肝脏脂质代谢和氧化还原状态的影响       | 慈文佳 陈 欣 蒋梦琪 朱建津                               |
| 1552 饲料苏氨酸水平对 43~63 日龄黄羽肉鸡生长性能、胴体品质和免疫功能的影响 | 林厦菁 席鹏彬 苟钟勇 程忠刚<br>阮 栋 郑春田 蒋守群                |

|      |                                                            |     |     |     |     |
|------|------------------------------------------------------------|-----|-----|-----|-----|
| 1561 | 混合纳米维生素 A、D、E 对肉鸡生产性能、肠道发育、免疫功能及抗氧化能力的影响                   | 刘筱影 | 马春来 | 尹振晨 | 秦凯龙 |
| 1572 | L-苹果酸对肉鸡生长性能、肉品质及抗氧化能力的影响                                  | 黄新活 | 杨小军 |     |     |
| 1585 | 饲料粗蛋白质与赖氨酸水平对北京油鸡育雏期生长性能和血清生化指标的影响                         | 鲍文梅 | 黄 飞 | 闾绍闾 | 赵芝琼 |
| 1596 | 新型复合抗氧化剂对青脚麻鸡生长性能及抗氧化功能的影响                                 | 张 祺 | 王立克 | 王 翔 | 王淑娟 |
| 1610 | 饲料中椰子粕和复合酶添加水平对蛋鸭抗氧化及脂类代谢指标的影响                             | 赵伟玉 | 常 彬 | 张倩倩 | 赵亚芳 |
| 1622 | 亚硒酸钠和酵母硒对蛋鸭产蛋性能、蛋品质、蛋硒含量和蛋硒转化率的影响                          | 王海宏 | 初 芹 | 张 剑 | 晏志勋 |
| 1638 | 沙棘黄酮对广西小麻鸭生长性能、肉品质、血清生化指标及免疫器官指数的影响                        | 宋志刚 | 耿爱莲 |     |     |
| 1649 | 饲料中 n-6/n-3 多不饱和脂肪酸比值对肉鹅生长性能、屠宰性能、血清脂质指标、肠道组织形态和胸肌脂肪酸组成的影响 | 孙刘锁 | 周维仁 | 闫俊书 | 宦海琳 |
| 1658 | 饲料添加胆汁酸对 16~23 周龄日本蛋鹌鹑生产性能、养分表观代谢率和血清生化指标的影响               | 张鑫蕊 | 葛志华 | 隋雁南 | 罗 阳 |
| 1666 | 围产前期补饲酵母硒对奶牛乳汁代谢物的影响                                       | 王 爽 | 夏伟光 | 陈 伟 | 黄雪冰 |
| 1675 | 辣椒碱对安格斯杂交阉牛生长性能、营养物质表观消化率及血清生化和抗氧化指标的影响                    | 李凯潮 | 金成龙 | 王胜林 | 郑春田 |
| 1684 | 饲料中添加烟酸对热应激肉牛血清生化、免疫和抗氧化指标的影响                              | 张亚男 |     |     |     |
| 1696 | 葛根多糖对犊牛血清抗氧化、免疫指标及肠道菌群的影响                                  | 金永燕 | 郑春田 | 陈 伟 | 王 爽 |
| 1705 | 70~90 kg 牦牛犊牛矿物质元素铜、铁、锌营养需要量研究                             | 夏伟光 | 刘文超 | 程镜蓉 | 张亚男 |
| 1716 | 哺乳期饲喂开食料对牦牛犊牛生长性能和肠道发育的影响                                  | 姚炳浓 | 廖富友 | 杨娇一 | 王 姣 |
| 1729 | 饲料中添加牛至精油对宰后不同成熟时间牛肉品质及抗氧化能力的影响                            | 祝保国 | 杨胜林 |     |     |
| 1740 | 云上黑山羊生长育肥公羊能量需要量研究                                         | 徐文双 | 王宝维 | 张名爱 | 凡文磊 |
| 1749 | 生长期云上黑山羊粗蛋白质需要量研究                                          | 朱玉霞 | 钱 旺 | 孔 敏 |     |
| 1758 | 羔羊代乳料对雷州山羊生长性能、养分表观消化率、瘤胃发酵参数和菌群结构及健康状况的影响                 | 袁 琪 | 肖圆圆 | 袁剑华 | 薛俊敬 |
| 1771 | 海氏肠球菌与糖蜜联合接种改善葡萄枝叶发酵品质及哈萨克羊养殖效果评价                          | 卿一青 | 郝隽毅 | 张 沙 | 方热军 |
|      |                                                            | 杜振隆 | 付力立 | 罗正中 | 马 莉 |
|      |                                                            | 周 涛 | 姚学萍 | 沈留红 | 余树民 |
|      |                                                            | 严作廷 | 曹随忠 |     |     |
|      |                                                            | 吴宝云 | 易 鑫 | 马婧蕾 | 周振明 |
|      |                                                            | 吴 浩 |     |     |     |
|      |                                                            | 龙 凡 | 邹必成 | 王丽华 | 瞿明仁 |
|      |                                                            | 陈传斌 | 杨建军 | 许兰娇 |     |
|      |                                                            | 吕尚揆 | 莘 余 | 樊 磊 | 张泽茹 |
|      |                                                            | 赵玉全 | 尤留超 | 张 钺 | 张 琼 |
|      |                                                            | 苏柘僮 | 曹随忠 | 余树民 | 沈留红 |
|      |                                                            | 操 君 | 张 博 | 段嘉钰 | 冯宇哲 |
|      |                                                            | 刘书杰 | 杨得玉 | 张晓卫 | 周 磊 |
|      |                                                            | 崔占鸿 |     |     |     |
|      |                                                            | 安乐乐 | 郭文杰 | 操 君 | 刘书杰 |
|      |                                                            | 杨得玉 | 崔占鸿 |     |     |
|      |                                                            | 马 越 | 王 瑛 | 李泽民 | 贾 莉 |
|      |                                                            | 史金平 | 张 瑞 | 雷 宇 | 贺鹏迦 |
|      |                                                            | 马彦男 | 刘立山 | 程 强 | 张 照 |
|      |                                                            | 张小强 | 张 晓 | 雷赵民 |     |
|      |                                                            | 高 欢 | 余 烨 | 殷彦华 | 赵 启 |
|      |                                                            | 武红德 | 李浩楠 | 陈 斓 | 吕亚琦 |
|      |                                                            | 张雨晨 | 冷 静 |     |     |
|      |                                                            | 付斌龙 | 高 欢 | 余 烨 | 赵 启 |
|      |                                                            | 武红德 | 王德澳 | 李 哲 | 张雨晨 |
|      |                                                            | 陈 斓 | 冷 静 |     |     |
|      |                                                            | 杨讯业 | 牛志力 | 吴 琼 | 刘英明 |
|      |                                                            | 李兴华 | 赵志辉 | 尹福泉 | 高振华 |
|      |                                                            | 陈永成 | 杨泽毅 | 李 肖 | 王旭哲 |
|      |                                                            | 张凡凡 | 马春晖 |     |     |

|      |                                                                        |                   |                   |                   |                   |
|------|------------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|
| 1781 | 纤维素酶和木聚糖酶处理大麦秸秆和玉米秸秆的绵羊瘤胃降解特性                                          | 王国秀<br>李 冲        | 马东方               | 黄永亮               | 陈占玉               |
| 1791 | 甘露寡糖对围产期湖羊母羊采食量、体重及血清生化指标的影响                                           | 张赛伟<br>郭云霞<br>张英杰 | 段春辉<br>纪守坤        | 张昕妍<br>严 慧        | 李 菲<br>刘月琴        |
| 1803 | 丁酸钠对哺乳期湖羊羔羊生长性能、血浆指标和瘤胃发育的影响                                           | 纪雯雯<br>李浙烽        | 云 燕<br>王 翀        | 张艳芳<br>茅慧玲        | 张衍震               |
| 1816 | 复合益生菌对羔羊粪便微生物及免疫指标的影响                                                  | 王海玉<br>段春辉<br>严 慧 | 郭云霞<br>张英杰        | 丁亚伟<br>刘月琴        | 田星哲<br>纪守坤        |
| 1827 | 岩藻多糖对断奶羔羊瘤胃微生物区系及代谢组学的影响                                               | 王胜男               | 杨伟光               | 尹福泉               |                   |
| 1841 | 饲喂不同比例红枣-棉粕精补料对哺乳驴驹生长发育及血清指标的影响                                        | 张淑贤<br>郝建东        | 许 涛<br>周小玲        | 李杨辉               | 贾瑜艳               |
| 1850 | 青藏高原中华羊茅不同部位的营养价值及分子结构特性研究                                             | 孙晓旭<br>陈有军        | 彭 婧<br>蔡晓蕊        | 江雨霏<br>黄艳玲        | 史海涛<br>李胜利        |
| 1863 | 不同灵芝菌株发酵小麦秸秆对纤维降解及营养成分变化的影响                                            | 高旭红               | 毛 磊               | 徐立春               | 梁小军               |
| 1870 | 苏北地区不同暂养阶段雄性中华绒螯蟹生长性能和营养品质的变化分析                                        | 吴 春               | 单金峰               | 周翰林               | 王信海               |
| 1883 | 饲料中添加发酵蚕沙对草鱼生长、消化、免疫及炎症反应的影响                                           | 吴仓仓<br>陈 静<br>汪 翔 | 何吉祥<br>陈夏君        | 吴本丽<br>张 烨        | 黄 龙<br>武 松        |
| 1895 | 蝉花菌质对大黄鱼生长性能、肝脏抗氧化能力和肠道菌群的影响                                           | 尹 恒<br>黄 玲        | 霍润明<br>王涵颖        | 柴若愚<br>王 萍        | 水晓梅               |
| 1910 | 酶解鸡血球蛋白粉替代鱼粉对卵形鲳鲆( <i>Trachinotus ovatus</i> )幼鱼生长性能、抗氧化能力、免疫力及肠道菌群的影响 | 岳 茹<br>虞 为<br>荀鹏伟 | 黄小林<br>宗志伦<br>黄健彬 | 谭小红<br>黄 忠<br>林黑着 | 周增太<br>周传朋        |
| 1926 | 褪黑素对青鱼生长、非特异性免疫、抗氧化能力、肠道消化酶活性以及肝脏胰岛素样生长因子 I 和热休克蛋白 70 mRNA 表达的影响       | 殷 淦<br>曹梦慧        | 王 天<br>叶金云        | 牛玉涵<br>明建华        | 杨 梅               |
| 1938 | 甘草提取物对冬毛期乌苏里貉生长性能、营养物质消化代谢、血清生化指标、毛皮品质及脏器指数的影响                         | 赵惠媛<br>刘 云        | 杨雅涵<br>张朝生        | 赵 芸<br>范庆忠        | 孔令钰<br>张海华        |
| 1948 | 复合酸化剂对伊拉兔空肠消化酶活性、免疫功能和紧密连接蛋白表达的影响                                      | 杨国峰<br>钟辛悦        | 贺佳仪<br>王长康        | 狄 斌<br>高玉云        | 谢秋萍               |
| 1957 | 饲料中添加透明质酸钠对猫采食性能、血液指标和毛皮健康的影响                                          | 张云海<br>王海英        | 崔 凯<br>乔莉苹        | 孙海涛<br>刘 策        | 刘公言               |
| 1966 | $\alpha$ -亚麻酸对猪颗粒细胞胆固醇合成、类固醇激素合成和凋亡的影响                                 | 吴登科<br>任格哈        | 郎育杰<br>褚瑰燕        | 刘 宁<br>武永厚        | 卢小斌<br>蔡传江        |
| 1976 | 白术多糖缓解环磷酰胺诱导的岭南黄鸡氧化应激和肝脏细胞凋亡                                           | 陈浩祥<br>李冰心<br>许丹宁 | 杨舒展<br>李婉雁<br>曹 楠 | 陆智儿<br>田允波        | 钱 隆<br>黄运茂        |
| 1985 | 克氏原螯虾内源性纤维素酶糖苷水解酶 9 基因家族鉴定及其表达分析                                       | 王霆辉<br>王爱民        | 李旭光<br>明建华        | 徐 宇<br>许志强        | 李佳佳               |
| 1996 | 猪后肢股动脉、股静脉血管瘘管安装方法的建立                                                  | 任 莹<br>张丹丹<br>王凤芹 | 吴涛涛<br>雷 龙<br>开丽霞 | 冯 志<br>徐学文<br>程远之 | 张 慧<br>赵胜军<br>汪以真 |
| 2004 | 固相萃取-超高效液相色谱-串联质谱法测定饲料中大观霉素                                            | 杨许花<br>刘红海        | 郭星晨<br>高丹丹        | 陈 红<br>马忠仁        | 袁旭红<br>李贞子        |
| 2018 | 柳茶多糖对环磷酰胺诱导的免疫抑制小鼠的免疫调节及抗炎作用                                           | 李晗星<br>石霖静<br>李俊杰 | 房晓欢<br>郑文静        | 齐雅天<br>李 琳        | 田 凯<br>陈家弟        |
| 2030 | 邻苯二甲酸二甲酯对小鼠生长性能、免疫性能及小肠组织形态的影响                                         |                   |                   |                   |                   |

# CHINESE JOURNAL OF ANIMAL NUTRITION

Collected by CSCD Core Library, Scopus Database, CAB Abstracts and Chemical Abstracts

Volume 35 Number 3 March 2023

## CONTENTS

### REVIEW

- 1361 Research Progress of Plant Ingredients and Canine Intestinal Health  
1368 Role of Short Chain Fatty Acids in Gut Brain Axis  
1380 Advances on Effects of Feeding Frequency on Feed Intake and Nitrogen Utilization of Swine  
1387 Roles and Mechanisms of Cytokines in Porcine Embryo Implantation Stage  
1396 Mechanisms of Anionic Diets for Prevention of Milk Fever in Cows and Advances in Its Application  
1405 Relationship Between Dietary Nutritional Structure Management and Chronic Kidney Disease in Cats  
1413 Research Progress of Quercetin in Regulating Animal Health and Diseases Based on Endoplasmic Reticulum Stress Signaling Pathway  
1426 Regulation of Silent Information Regulator 2-Related Enzyme 1 on Milk Fat, Milk Protein Synthesis and Mastitis and Its Possible Mechanism  
1433 Application of Alternative Technology for Soybean Meal Reduction for Feed and Development Prospect of New Protein Feed  
1444 Research Progress in Regulatory Effects of Flavonoids on Animal Gastrointestinal Health  
1454 Research Progress on Role and Mechanism of Proanthocyanidins in Regulating Immune Response by Shaping Intestinal Microbiota  
1468 Biological Functions of *Pogostemon cablin* and Its Application in Livestock Production  
1475 Research Progress of Biological Additives in Silage

### RESEARCH PAPER

- 1489 Effects of Low Protein Diet Supplemented with-Fermented Canola Meal on Growth Performance and Meat Quality of Finishing Pigs  
1501 Whole Intestinal Succession of Dominant *Lactobacilli* in Small Intestine of Piglets Before and after Weaning and Their Comparative Metabolomics  
1513 Dynamic Change of Apoptosis and Autophagy Signal Pathways in Intestinal Tract of Weaned Piglets after Lipopolysaccharide Challenge at Different Time Points  
1520 A Meta Analysis of Effects of Probiotics on Growth Performance of Weaned Piglets Under Intestinal Injury Conditions  
1532 Effects of *Ganoderma Lucidum* Powder on Performance, Egg Quality, Immune Function and Antioxidant Ability of Local Hens  
1540 Effects of *Sini* Powder with *Pueraria* Mixture on Liver Lipid Metabolism and Redox Status of Late-Phase Laying Hens  
1552 Effects of Dietary Threonine Level on Growth Performance, Carcass Quality and Immune Function of Yellow-Feathered Broilers from 43 to 63 Days of Age  
1561 Effects of Mixed Nano-Vitamins A, D and E on Performance, Intestinal Development, Immune Function and Antioxidant Ability of Broilers  
1572 Effects of *L-Malic Acid* on Growth Performance, Meat Quality and Antioxidant Capacity of Broilers

ZHANG Peng, WANG Siyuan, LI Yufu, Korotkova Irina Pavlovna  
YANG Xue, GAO Yanan, WANG Jiaqi, ZHENG Nan  
FU Xin, ZHANG Qiyu, QIN Guixin, ZHAO Yuan  
PAN Xujing, CHANG Junlei, WU De, XU Shengyu  
YUAN Jing, LI Shengli, WANG Shuo, WANG Wei  
JIA Huizhen, ZHANG Anrong, WU Zhenlong, YANG Ying  
MEI Huadi, CHEN Qiuyu, MA Xianyong, YU Miao

CAO Peipei, JI Sitong, DOU Wenli, MA Yanfen

GAO Pengxiang, PAN Yucong, JIANG Linshu, FANG Luoyun  
LI Lanzhu, HU Honglian, GAO Min, SUN Manji  
SU Lingling, LI Xiaoyin, YI Hongbo, GAO Yanhua  
KANG Libo, LI Yi, DENG Hongda, SONG Xiaozhen  
YI Qixuan, WANG Peng

GU Fang, LIU Shilong, LI Hongsheng, NI Dongjiao, WANG Li, XU Xiaoming, WU Shansen, JIN Zhenhao, YANG Xuefen, JIANG Zongyong  
LIU Moyan, HAO Youling, SONG Qingqing, CHEN Hui, SUN Shiqiang, LI Ju, WU Zhenlong, DAI Zhaolai  
QIN Xu, ZHOU Mohan, YU Xintian, CHEN Shaokui, LIU Yulan, XIAO Kan

GAO Jingchun, CAO Shuting, YAO Kang, HUANG Kaiyong, LI Yaojie, HE Zhentao, ZHAN Xianliang, JIANG Zongyong, WANG Li  
NIU Jinguo, ZHANG Xiyao, SHEN Liyan, ZHANG Qi, YE Hongxin, LI Peifeng, LI Yani  
CI Wenjia, CHEN Xin, JIANG Mengqi, ZHU Jianjin  
LIN Xiajing, XI Pengbin, GOU Zhongyong, CHENG Zhonggang, RUAN Dong, ZHENG Chuntian, JIANG Shouqun  
LIU Xiaoying, MA Chunlai, YIN Zhenchen, QIN Kailong, HUANG Xinhua, YANG Xiaojun  
BAO Wenmei, HUANG Fei, CHUANG Shaochuang, ZHAO Zhiqiong, ZHANG Qi, WANG Like, WANG Xiang, WANG Shujuan

- 1585 Effects of Dietary Crude Protein and Lysine Levels on Growth Performance and Serum Biochemical Indexes of *Beijing You Chickens* during Brooding Period
- 1596 Effects of New Compound Antioxidants on Growth Performance and Antioxidant Function of Cyan-Shank Partridge Chickens
- 1610 Effects of Dietary Copra Meal and Compound Enzyme Supplemental Levels on Antioxidant and Lipid Metabolism Indexes of Laying Ducks
- 1622 Effects of Sodium Selenite and Selenium Yeast on Laying Performance, Egg Quality, Egg Selenium Content and Egg Selenium Conversion Rate of Laying Ducks
- 1638 Effects of Dietary Supplementation of Sea Buckthorn Flavonoids on Growth Performance, Meat Quality, Serum Biochemical Indexes and Immune Organ Indexes of *Guangxi* Small Hemp Ducks
- 1649 Effects of Dietary n-6/n-3 Polyunsaturated Fatty Acid Ratio on Growth Performance, Slaughter Performance, Serum Lipid Indices, Intestinal Morphology and Breast Muscle Fatty Acid Composition of Meat Geese
- 1658 Effects of Dietary Bile Acid on Performance, Nutrient Apparent Metabolic Rates and Serum Biochemical Indices of Laying Japanese Quails from 16 to 23 Weeks of Age
- 1666 Effects of Selenium Yeast Supplementation during Preperinatal Period on Milk Metabolites in Dairy Cows
- 1675 Effects of Capsaicin on Growth Performance, Nutrient Apparent Digestibility and Serum Biochemical and Antioxidant Parameters of Angus Crossbred Steers
- 1684 Effects of Dietary Niacin on Serum Biochemical, Immune and Antioxidant Indexes of Beef Cattle under Heat Stress
- 1696 Effects of *Pueraria* Polysaccharides on Serum Antioxidant and Immune Indexes and Gut Microbiota of Calves
- 1705 Study on Nutrient Requirement of Mineral Elements Copper, Iron and Zinc of 70 to 90 kg Yak Calves
- 1716 Effects of Feeding Starter during Lactation on Growth Performance and Intestinal Development of Yak Calves
- 1729 Effects of Dietary Supplementation of Oregano Essential Oil on Meat Quality and Antioxidant Capacity of Beef at Different Post-mortem Aging Time
- 1740 Study on Energy Requirement of *Yunshang* Black Goat Growing and Fattening Rams
- 1749 Crude Protein Requirement of *Yunshang* Black Goats during Growth Period
- 1758 Effects of Lamb Milk Replacer on Growth Performance, Apparent Nutrient Digestibility, Rumen Fermentation Parameters, Microflora Structure and Health Status of *Leizhou* Goats
- 1771 Improvement of Fermentation Quality of Grape Branch and Leaf by Combined Inoculation of *Enterococcus hirae* and Molasses and Evaluation of Breeding Effect of Kazakh Sheep
- 1781 Degradation Characteristics of Cellulase and Xylanase Treated Barley Straw and Corn Straw in Sheep Rumen
- 1791 Effects of Mannan Oligosaccharide on Feed Intake, Body Weight and Serum Biochemical Indexes of Perinatal *Hu* Sheep Ewes
- ZHAO Weiyu, CHANG Cheng, ZHANG Qianqian, ZHAO Yafang, WANG Haihong, CHU Qin, ZHANG Jian, YAN Zhixun, SONG Zhigang, GENG Ailian, SUN Liusuo, ZHOU Weiren, YAN Junshu, HUAN Hailin, ZHANG Xinrui, GE Zhihua, SUI Yannan, LUO Yang, WANG Shuang, XIA Weiguang, CHEN Wei, HUANG Xuebing, LI Kaichao, JIN Chenglong, WANG Shenglin, ZHENG Chuntian, ZHANG Ya'nan, JIN Yongyan, ZHENG Chuntian, CHEN Wei, WANG Shuang, XIA Weiguang, LIU Wenchao, CHENG Jingrong, ZHANG Yanan, YAO Bingnong, LIAO Fuyou, YANG Jiaoyi, WANG Jiao, ZHU Baoguo, YANG Shenglin, XU Wenshuang, WANG Baowei, ZHANG Mingai, FAN Wenlei, ZHU Yuxia, QIAN Wang, KONG Min, YUAN Qi, XIAO Yuanyuan, YUAN Jianhua, XUE Junjing, QING Yiqing, HAO Junyi, ZHANG Sha, FANG Rejun, DU Zhenlong, FU Lili, LUO Zhengzhong, MA Li, ZHOU Tao, YAO Xueping, SHEN Liuhong, YU Shumin, YAN Zuoting, CAO Suizhong, WU Baoyun, YI Xin, MA Jinglei, ZHOU Zhenming, WU Hao, LONG Fan, ZOU Bicheng, WANG Lihua, QU Mingren, CHEN Chuanbin, YANG Jianjun, XU Lanjiao, LYU Shanghui, SHEN Yu, FAN Lei, ZHANG Zeru, ZHAO Yuquan, YOU Liuchao, ZHANG Yue, ZHANG Qiong, SU Zhetong, CAO Suizhong, YU Shumin, SHEN Liuhong, CAO Jun, ZHANG Bo, DUAN Jiayu, FENG Yuzhe, LIU Shujie, YANG Deyu, ZHANG Xiaowei, ZHOU Lei, CUI Zhanhong, AN Lele, GUO Wenjie, CAO Jun, LIU Shujie, YANG Deyu, CUI Zhanhong, MA Yue, WANG Ying, LI Zemin, JIA Li, SHI Jinping, ZHANG Rui, LEI Yu, HE Pengjia, MA Yannan, LIU Lishan, CHENG Qiang, ZHANG Zhao, ZHANG Xiaoqiang, ZHANG Xiao, LEI Zhaomin, GAO Huan, YU Ye, YIN Yanhua, ZHAO Qi, WU Hongde, LI Haonan, CHEN Lan, LYU Yaqi, ZHANG Yuchen, LENG Jing, FU Binlong, GAO Huan, YU Ye, ZHAO Qi, WU Hongde, WANG Deao, LI Zhe, ZHANG Yuchen, CHEN Lan, LENG Jing, YANG Xunye, NIU Zhili, WU Qiong, LIU Yingming, LI Xinghua, ZHAO Zhihui, YIN Fuquan, GAO Zhenhua, CHEN Yongcheng, YANG Zeyi, LI Xiao, WANG Xuzhe, ZHANG Fanfan, MA Chunhui, WANG Guoxiu, MA Dongfang, HUANG Yongliang, CHEN Zhanyu, LI Chong, ZHANG Saiwei, DUAN Chunhui, ZHANG Xinyan, LI Fei, GUO Yunxia, JI Shoukun, YAN Hui, LIU Yueqin, ZHANG Yingjie

- 1803 Effects of Sodium Butyrate on Growth Performance, Plasma Indexes, Rumen Development of *Hu* Lambs during Suckling Period
- 1816 Effects of Compound Probiotics on Fecal Microorganisms and Immune Indexes of Lambs
- 1827 Effects of Fucoidan on Rumen Microflora and Metabolomics of Weaned Lambs
- 1841 Effects of Feeding Concentrate Supplements Containing Different Proportions of Jujube-Cotton Meal on Growth and Development and Serum Indices of Suckling Donkey Foals
- 1850 Nutritional Value and Molecular Structure Characteristics in Different Parts of *Festuca sinensis* from Qinghai-Tibet Plateau
- 1863 Effects of Different *Ganoderma lucidum* Strains Fermenting Wheat Straw on Fiber Degradation and Nutrient Change
- 1870 Changes in Growth and Nutritional Quality of Male *Eriocheir sinensis* in Different Hoarding Time in Northern Jiangsu
- 1883 Effects of Dietary Fermented Silkworm Excrement on Growth, Digestive, Immune and Inflammation of Grass Carp (*Ctenopharyngodon idella*)
- 1895 Effects of *Isaria cicadae* Spent Mushroom Substrate on Growth, Liver Antioxidant Capacity and Intestinal Microflora of Large Yellow Croaker (*Larimichthys crocea*)
- 1910 Effects of Enzymolytic Chicken Hemoglobin Meal Replacing Fish Meal on Growth Performance, Antioxidant Capacity, Immunity and Intestinal Flora of Juvenile *Trachinotus ovatus*
- 1926 Effects of Melatonin on Growth, Non-Specific Immunity, Antioxidant Capacity, Intestinal Digestive Enzyme Activities and mRNA Expression of Insulin-Like Growth Factor-I and Heat Shock Protein 70 in Liver of Black Carp (*Mylopharyngodon piceus*)
- 1938 Effects of Licorice Extract on Growth Performance, Digestion and Metabolism of Nutrients, Serum Biochemical Indexes, Fur Quality and Organ Indexes of Fur-Growing Raccoon Dogs
- 1948 Effects of Compound Acidifier on Digestive Enzyme Activity, Immune Function and Tight Junction Protein Expression in Jejunum of Ira Rabbits
- 1957 Effects of Dietary Sodium Hyaluronate on Feeding Performance, Blood Indices and Fur Health of Cats
- 1966 Effects of  $\alpha$ -Linolenic Acid on Cholesterol Synthesis, Steroid Hormone Synthesis and Apoptosis of Porcine Granulosa Cells
- 1976 Polysaccharide of *Atractylodes macrocephala* Koidz Alleviates Cyclophosphamide Induced Oxidative Stress and Apoptosis in Liver of Lingnan Yellow Chickens
- 1985 Identification and Expression Analysis of Endogenous Cellulase Glycoside Hydrolase 9 Gene Family in *Procambarus clarkii*
- 1996 A Technique Establishing for Installing Femoral Artery and Femoral Vein Vascular Fistula in Pig Hind Limbs
- 2004 Determination of Spectinomycin in Feed by Solid Phase Extraction-Ultra Performance Liquid Chromatography-Tandem Mass Spectrometry
- 2018 Immune Regulation and Anti-Inflammatory Effect of *Sibiraea angustata* Polysaccharides on Immunosuppressed Mice Induced by Cyclophosphamide
- 2030 Effects of Dimethyl Phthalate on Growth Performance, Immune Performance and Small Intestinal Tissue Morphology of Mice
- JI Wenwen, YUN Yan, ZHANG Yanfang, ZHANG Yanzhen, LI Zhefeng, WANG Chong, MAO Huiling
- WANG Haiyu, GUO Yunxia, DING Yawei, TIAN Xingzhe, DUAN Chunhui, ZHANG Yingjie, LIU Yueqin, JI Shoukun, YAN Hui
- WANG Shengnan, YANG Weiguang, YIN Fuquan
- ZHANG Shuxian, XU Tao, LI Yanghui, JIA Yuyan, HAO Jiandong, ZHOU Xiaoling
- SUN Xiaoxu, PENG Jing, JIANG Yufei, SHI Haitao, CHEN Youjun, CAI Xiaorui, HUANG Yanling, LI Shengli
- GAO Xuhong, MAO Lei, XU Lichun, LIANG Xiaojun
- WU Chun, SHAN Jinfeng, ZHOU Hanlin, WANG Xinhai
- WU Cangang, HE Jixiang, WU Benli, HUANG Long, CHEN Jing, CHEN Xiajun, ZHANG Ye, WU Song, WANG Xiang
- YIN Heng, HUO Runming, CHAI Ruoyu, SHUI Xiaomei, HUANG Ling, WANG Hanying, WANG Ping
- YUE Ru, HUANG Xiaolin, TAN Xiaohong, ZHOU Zengtai, YU Wei, ZONG Zhilun, HUANG Zhong, ZHOU Chuanpeng, XUN Pengwei, HUANG Jianbin, LIN Heizhao
- YIN Gan, WANG Tian, NIU Yuhan, YANG Mei, CAO Menghui, YE Jinyun, MING Jianhua
- ZHAO Huiyuan, YANG Yahan, ZHAO Yun, KONG Lingyu, LIU Yun, ZHANG Chaosheng, FAN Qingzhong, ZHANG Haihua
- YANG Guofeng, HE Jiayi, DI Bin, XIE Qiuping, ZHONG Xinyue, WANG Changkang, GAO Yuyun
- ZHANG Yunhai, CUI Kai, SUN Haitao, LIU Gongyan, WANG Haiying, QIAO Liping, LIU Ce
- WU Dengke, LANG Yujie, LIU Ning, LU Xiaobin, REN Gehan, CHU Guiyan, WU Yonghou, CAI Chuanjiang
- CHEN Haoxiang, YANG Shuzhan, LU Zhi-er, QIAN Long, LI Bingxin, LI Wanyan, TIAN Yunbo, HUANG Yunmao, XU Danning, CAO Nan
- WANG Tinghui, LI Xuguang, XU Yu, LI Jiajia, WANG Aimin, MING Jianhua, XU Zhiqiang
- REN Ying, WU Taotao, FENG Zhi, ZHANG Hui, ZHANG Dandan, LEI Long, XU Xuwen, ZHAO Shengjun
- WANG Fengqin, KAI Lixia, CHENG Yuanzhi, WANG Yizhen
- YANG Xuhua, GUO Xingchen, CHEN Hong, YUAN Xuhong, LIU Honghai, GAO Dandan, MA Zhongren, LI Zhenzi
- LI Hanxing, FANG Xiaohuan, QI Yatian, TIAN Kai, SHI Linjing, ZHENG Wenjing, LI Lin, CHEN Jiadi, LI Junjie

《动物营养学报》编委会

顾 问 麦康森（院士） 南志标（院士） 李德发（院士） 印遇龙（院士）  
姚 斌（院士） 侯水生（院士） 谯仕彦（院士）

主 任 委 员 蒋宗勇

副主任委员 谯仕彦 齐广海 汪以真 朱伟云 吴 德 谭支良 李爱科 姚军虎

主 编 计 成

副 主 编 齐广海（常务） 汪以真 吴 德 姚军虎

委 员（按姓名英文字母/汉字笔画排序）

Mingan Choct (Australia) Ming Z. Fan (Canada) Leluo Guan (Canada)  
Xingen Lei (USA) Shimin Liu (Australia) Chris McSweeney (Australia)  
Guoyao Wu (USA) Tianhai Yan (UK) Fengqi Zhao (USA)

卜登攀 刁其玉 王加启 王军军 王志祥 王佳莹 王洪荣 王 恬 王康宁 车东升  
毛胜勇 文 杰 计 成 尹靖东 孔祥峰 石宝明 印遇龙 乐国伟 冯 杰 冯定远  
成艳芬 朱伟云 乔家运 刘玉兰 刘作华 刘建新 齐广海 齐德生 闫素梅 江青艳  
麦康森 李建国 李绍钰 李胜利 李爱科 李福昌 李德发 杨小军 杨飞云 杨汉春  
杨 琳 吴 德 吴于明 何 军 佟建明 余 冰 汪以真 汪 傲 张克英 张宏福  
张爱忠 张敏红 张 微 陈 文 陈代文 武振龙 林 海 罗绪刚 周小秋 周志刚  
郑春田 单安山 孟庆翔 赵广永 南志标 侯水生 侯永清 侯先志 姚军虎 姚 斌  
贺建华 贺 喜 秦贵信 敖长金 贾志海 晏向华 徐子伟 高秀华 屠 焰 彭 健  
蒋林树 蒋宗勇 游金明 蔡辉益 管武太 雒秋江 谭支良 谯仕彦 熊本海 薛 敏  
瞿明仁

编 辑 部

主 任 赵广永

副 主 任 尹靖东

责 任 编 辑 菅景颖 武海龙 陈 鑫 田艳明 主任助理兼网络编辑 窦志斌 编务兼排版 景正芳

|                  |                                 |                                     |                                                                                                |
|------------------|---------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------|
| 动物营养学报           |                                 | CHINESE JOURNAL OF ANIMAL NUTRITION |                                                                                                |
| (月刊, 1989年创刊)    |                                 | (Monthly, Since 1989)               |                                                                                                |
| 第35卷 第3期 2023年3月 |                                 | Vol.35 No.3 March 2023              |                                                                                                |
| 主 管              | 中国科学技术协会                        | Supervised by                       | China Association for Science and Technology                                                   |
| 主 办              | 中国畜牧兽医学会                        | Organized by                        | Chinese Association of Animal Science and Veterinary Medicine                                  |
| 编 辑              | 《动物营养学报》编辑部                     | Edited by                           | Editorial Department of CHINESE JOURNAL OF ANIMAL NUTRITION Branch Society of Animal Nutrition |
| 地 址              | 北京市海淀区圆明园西路2号中国农业大学西区动科动医大楼153室 | Address                             | No.2 Yuanmingyuan West Road, Haidian Beijing, China                                            |
| 邮 编              | 100193                          | Postcode                            | 100193                                                                                         |
| 电 话              | 010-62817823 010-62734530       | Telephone                           | 010-62817823 010-62734530                                                                      |
| 网 址              | http://www.ChinaJAN.com         | Website                             | http://www.ChinaJAN.com                                                                        |
| 电 子 邮 箱          | yyxb@cau.edu.cn                 | E-mail                              | yyxb@cau.edu.cn                                                                                |
| 出 版              | 《中国畜牧兽医杂志》有限公司                  | Published by                        | Chinese Journal of Animal Science and Veterinary Medicine Co., Ltd.                            |
| 印 刷              | 北京科信印刷有限公司                      | Distributed by                      | Domestic Beijing Post Office Overseas China International Book Trading Corporation             |
| 国内总发行            | 北京报刊发行局                         |                                     |                                                                                                |
| 国外总发行            | 中国国际图书贸易集团有限公司                  |                                     |                                                                                                |
| 订 购              | 全国各地邮政局（所）                      |                                     |                                                                                                |
| 中国标准连续出版物号       | ISSN 1006-267X<br>CN 11-5461/S  |                                     |                                                                                                |

国内邮发代号：80-591 广告发布登记证号：京海工商广登字20170255号  
国际邮发代号：M4978 国内定价：150.00元

ISSN 1006-267X

