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## 凡纳滨对虾对13种动物性饲料原料营养物质表观消化率的研究

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## Apparent Digestibility of Nutrients in Thirteen Animal Feed Ingredients for White Shrimp *Litopenaeus vannamei*

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**摘要** 本试验以三氧化二钇( $Y_2O_3$ )为指示剂,由70%的基础饲料和30%的待测原料组成试验饲料,旨在研究凡纳滨对虾(*Litopenaeus vannamei*)对13种动物性饲料原料的营养物质表观消化率。13种动物性饲料原料分别为:白鱼粉(俄罗斯)、低温蒸汽红鱼粉(秘鲁)、国产直火干燥鱼粉、进口直火干燥鱼粉(秘鲁)、下杂鱼粉、血球蛋白粉、烘干血粉、鸡肉粉、肉骨粉、肉粉、酵解羽毛粉、水解羽毛粉和全虾粉。选取初始均重为(13.0±0.1)g的凡纳滨对虾1260尾,随机分为14组,每组3个重复,每个重复30尾虾。各组对虾分别投喂相应试验饲料1周后,采用虹吸法收粪,测定干物质、粗蛋白质、粗脂肪、总能、总磷和氨基酸的表观消化率。结果表明:13种饲料原料的干物质、粗蛋白质、粗脂肪、总能、总磷和氨基酸的表观消化率范围分别为58.11%~76.91%、64.17%~93.57%、52.44%~95.62%、43.00%~95.21%、39.11%~76.47%和63.48%~94.06%。各饲料原料的氨基酸表观消化率与粗蛋白质表观消化率变化趋势基本一致。白鱼粉、低温蒸汽红鱼粉和进口直火干燥鱼粉的粗蛋白质表观消化率显著高于其他各饲料原料( $P<0.05$ );酵解羽毛粉、水解羽毛粉和烘干血粉的粗脂肪表观消化率显著低于其他各饲料原料( $P<0.05$ );白鱼粉和进口直火干燥鱼粉的总能表观消化率显著高于其他各饲料原料( $P<0.05$ );白鱼粉、低温蒸汽红鱼粉、国产直火干燥鱼粉和进口直火干燥鱼粉的总磷表观消化率显著高于血球蛋白粉和烘干血粉( $P<0.05$ )。13种动物性饲料原料中白鱼粉的干物质、总能和总磷的表观消化率最高,水解羽毛粉的干物质、粗蛋白质和总能的表观消化率最低,烘干血粉的粗脂肪和总磷的表观消化率最低。由此可见,不同来源和品质的鱼粉的营养物质表观消化率不同;鸡肉粉、肉骨粉、肉粉和全虾粉可作为凡纳滨对虾的优质蛋白质源,在实际生产中可部分替代鱼粉;羽毛粉和血粉由于所采用的加工工艺不同,其营养物质组成有所不同,导致表观消化率有一定的差异,在配制饲料前需对其进行营养价值的评定。

**关键词:** 凡纳滨对虾 饲料原料 营养物质 表观消化率

**Abstract:** Apparent digestibility of nutrients in thirteen animal feed ingredients was determined for white shrimp *Litopenaeus vannamei* in this experiment. The thirteen animal feed ingredients included white fish meal (Russia), low-temperature steam dried brown fish meal (Peru), domestic flame dried fish meal, imported flame dried fish meal (Peru), miscellaneous fish meal, spray-dried blood cells, drying blood meal, chicken meal, meat and bone meal, meat meal, fermented feather meal, hydrolyzed feather meal, and shrimp meal. Trial diets used with yttrium oxide ( $Y_2O_3$ ) as an indicator, and consisted of 70% basal diet and 30% test ingredients. One thousand two hundred and sixty shrimp with an initial average body weight of (13.0±0.1) g were randomly divided into 14 groups with 3 replicates per group and 30 shrimp per replicate. After one week feeding with trial diets, the fecal samples were collected by siphon, then the apparent digestibility of dry matter, crude protein, crude lipid, gross energy, total phosphorous and amino acids was determined. The results showed as follows: apparent digestibility of dry matter, crude protein, crude lipid, gross energy, total phosphorous and amino acids in thirteen animal feed ingredients were 58.11% to 76.91%, 64.17% to 93.57%, 52.44% to 95.62%, 43.00% to 95.21%, 39.11% to 76.47%, and 63.48% to 94.06%, respectively. The apparent digestibility of amino acids had a positive correlation with apparent digestibility of crude protein for feed ingredients. The apparent digestibility of crude protein in white fish meal, low-temperature steam dried brown fish meal and imported flame dried fish meal was significant higher than that in other feed ingredients ( $P<0.05$ ); the apparent digestibility of crude lipid in fermented feather meal, hydrolyzed feather meal and drying blood meal was significantly lower than that in other feed ingredients ( $P<0.05$ ); the apparent digestibility of gross energy in white fish meal and imported flame dried fish meal was significantly higher than that in other feed ingredients ( $P<0.05$ ); the apparent digestibility of total phosphorus in white fish meal, low-temperature steam dried

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brown fish meal, flame dried fish meal and imported flame dried fish meal was significantly higher than that in spray-dried blood cells and drying blood meal ( $P < 0.05$ ). In the thirteen feed ingredients, the highest apparent digestibility of dry matter, gross energy and total phosphorus was found in white fish meal; the lowest apparent digestibility of dry matter, crude protein and gross energy was found in hydrolyzed feather meal; the lowest apparent digestibility of crude lipid was found in drying blood meal. In conclusion, different sources and qualities of fish meal lead to different apparent digestibility of nutrients. The chicken meal, meat and bone meal, meat meal and shrimp meal were high quality protein sources for *L. vannamei*, and they can be used to instead of part of fish meal in actual feed production. While, because of the different produce processes of feather meal and blood meal, the nutrient composition is different among the products, and that lead to the different apparent digestibility. So, the nutrient composition of these feed ingredients should be evaluated before formulating diets.

Keywords: white shrimp *Litopenaeus vannamei*, feed ingredient, nutrient, apparent digestibility

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- [1] 韩庆炜, 梁萌青, 姚宏波, 等. 鲈鱼对7种饲料原料的表观消化率及其对肝脏、肠道组织结构的影响[J]. 渔业科学进展, 2011, 32(1): 32-39.
- [2] 李爱杰. 水产动物营养与饲料学[M]. 北京: 农业出版社, 1996.
- [3] TERRAZAS-FIERRO M, CIVERA-CERECEDO R, IBARRA-MARTINEZ L, et al. Apparent digestibility of dry matter, protein, and essential amino acid in marine feedstuffs for juvenile whiteleg shrimp *Litopenaeus vannamei*[J]. Aquaculture, 2010, 308: 166-173.
- [4] YANG Q H, ZHOU X Q, ZHOU Q C, et al. Apparent digestibility of selected feed ingredients for white shrimp *Litopenaeus vannamei*, Boone [J]. Aquaculture Research, 2009, 41: 78-86.
- [5] BRUNSON J F, ROMAIRE R, REIGH R C. Apparent digestibility of selected ingredients in diets for white shrimp *Penaeus setiferus* L. [J]. Aquaculture Research, 1997, 3: 9-16.
- [6] 唐晓亮, 曹俊明, 朱选, 等. 7种饲料原料蛋白质和氨基酸对凡纳滨对虾的影响[J]. 饲料研究, 2010(2): 5-8.
- [7] 杨志强, 曹俊明, 朱远, 等. 凡纳滨对虾对7种蛋白原料的蛋白质和氨基酸的消化率[J]. 饲料工业, 2010, 31(2): 24-27.
- [8] 刘襄河. 凡纳滨对虾对蛋白质饲料原料消化率的研究及饲料配方实践. 硕士学位论文. 厦门: 集美大学, 2011.
- [9] 刘襄河, 孔江红, 周晔, 等. 南美白对虾对四种蛋白质原料的离体消化率和酶解动力学研究[J]. 饲料工业, 2009, 30(24): 27-30.
- [10] AKIYAMA D M, DOMINY W G, LAWRENCE A L. Penaeid shrimp nutrition[M]//FAST A W, LESTER L J. Marine shrimp culture: principles and Practices. Amsterdam: Elsevier, 1992: 555-568.
- [11] CHO C Y, SLINGER S J. Apparent digestibility measurement in feedstuff for rainbow trout[M]//HALVER J E, TIEWS K. Finfish nutrition and fish feed technology, Vol. II. Berlin: Heeneman, 1979: 239-248.
- [12] LIN H Z, GUO Z X, YANG Y Y, et al. Effect of dietary traditional Chinese medicines on apparent digestibility coefficients of nutrients for white shrimp *Litopenaeus vannamei*, Boone[J]. Aquaculture, 2006, 253: 495-501.
- [13] BUREAU D P, HARRIS A M, CHO C Y. Apparent digestibility of rendered animal protein ingredients for rainbow trout (*Oncorhynchus mykiss*) [J]. Aquaculture, 1999, 180: 345-358.
- [14] ALTAN O, KORKUT A Y. Apparent digestibility of plant protein based diets by European sea bass *Dicentrarchus labrax* L., 1758[J]. Turkish Journal of Fisheries and Aquatic Sciences, 2011, 11: 87-92.
- [15] YUAN Y C, GONG S Y, YANG H J, et al. Apparent digestibility of selected feed ingredients for Chinese sucker, *Myxocyprinus asiaticus* [J]. Aquaculture, 2010, 306: 238-243.
- [16] KUMARAGURU-VASAGAM K P, BALASUBRAMANIAN R, VENKATESAN R. Apparent digestibility of differently processed grain legumes, cow pea and mung bean in black tiger shrimp, *Penaeus mondon* Fabricius and associated histological anomalies in hepatopancreas and midgut[J]. Animal Feed Science and Technology, 2007, 132: 250-266.
- [17] TESHIMA S, KANAZAWA A. Digestibility of dietary lipids in the prawn[J]. Bulletin of the Japanese Scientific Fisheries, 1983, 49: 963-966.
- [18] PAVASOVIC A, ANDERSON A J, MATHER P B, et al. Effect of a variety of animal, plant and single cell-based feed ingredients on diet digestibility and digestive enzyme activity in redclaw crayfish, *Cherax quadricarinatus* (Von Martens 1868)[J]. Aquaculture, 2007, 272: 564-572.
- [19] NIETO-LOPEZ M, TAPIA-SALAZAR M, RICQUE-MARIE D, et al. Digestibility of different wheat products in white shrimp *Litopenaeus vannamei* juveniles[J]. Aquaculture, 2011, 391: 369-376.

- [20] CATA CUTAN M. Apparent digestibility of diets with various carbohydrate levels and the growth response of *Penaeus monodon* [J]. *Aquaculture*, 1991, 95: 89-96.
- [21] DEERING M J, HEWITT D R, SARAC H Z. A comparison of inert markers used to estimate protein digestibility in the leader prawn *Penaeus monodon* [J]. *Journal of the World Aquaculture Society*, 1996, 27: 103-106.
- [22] RING E. Does chromic oxide ( $\text{Cr}_2\text{O}_3$ ) affect faecal lipid and intestinal bacterial flora in Arctic charr (*Salvelinus alpinus*) [J]. *Aquaculture and Fisheries Management*, 1993, 24: 767-776.
- [23] SHIAU S Y, LIANG H S. Carbohydrate utilization and digestibility by tilapia, *Oreochromis niloticus* × *O. aureus*, are affected by chromic oxide inclusion in the diet [J]. *The Journal of Nutrition*, 1995, 125: 975-982.
- [24] BOWEN S H. Chromic oxide in assimilation studies—a caution [J]. *Transactions American Fisheries Society*, 1978, 107: 755-756.
- [25] MOORE J H. Diurnal variations in the compositions of the feces of pigs on diets containing chromium oxide [J]. *Journal of the World Aquaculture Society*, 1957, 11: 273-288.
- [26] 赵万鹏, 刘永坚, 潘庆. 草鱼对碳水化合物表观消化率测定方法的研究 [J]. *中山大学学报*, 1999, 38(4): 87-91.
- [27] MC GOOGAN B B, REIGH R C. Apparent digestibility of selected ingredients in red drum (*Sciaenops ocellatus*) diets [J]. *Aquaculture*, 1996, 141: 233-244.
- [28] SUGIURA S H, DONG F M, RATHBONE C K, et al. Apparent protein digestibility and mineral availabilities in various feed ingredients for salmonid feeds [J]. *Aquaculture*, 1998, 159: 177-202.
- [29] AUSTRENG E, STOREBAKKEN T, THOMASSEN M S, et al. Evaluation of selected trivalent metal oxides as inert markers used to estimate apparent digestibility in salmonids [J]. *Aquaculture*, 2000, 188: 65-78.
- [30] 张璐, 陈立侨, 洪美玲, 等. 中华绒螯蟹对11种饲料原料蛋白质和氨基酸的表观消化率 [J]. *水产学报*, 2007, 31(增刊): 116-121.
- [31] 周歧存, 麦康森, 刘永坚, 等. 动植物蛋白源替代鱼粉研究进展 [J]. *水产学报*, 2005, 29(3): 404-410.
- [32] 荣长宽, 梁素秀, 岳炳宜. 中国对虾对16种饲料的蛋白质和氨基酸的消化率 [J]. *水产学报*, 1994, 18(2): 131-137.
- [33] CATA CUTAN M R, EUSEBIO P S, TESHIMA S. Apparent digestibility of selected feedstuffs by mud crab, *Scylla serrata* [J]. *Aquaculture*, 2003, 216: 253-261.
- [34] ZHOU Q C, TAN B P, MAI K S, et al. Apparent digestibility of selected feed ingredients for juvenile cobia *Rachycentron canadum* [J]. *Aquaculture*, 2004, 241: 441-451.
- [35] LIN H, LIU Y, TIAN L, et al. Apparent digestibility coefficients of various feed ingredients for grouper *Epinephelus coioides* [J]. *Journal of the World Aquaculture Society*, 2004, 35: 134-142.
- [36] 董晓慧, 郭云学, 叶继丹, 等. 吉富罗非鱼幼鱼对10种饲料原料表观消化率的研究 [J]. *动物营养学报*, 2009, 21(3): 326-334.
- [37] BUREAU D P, HARRIS A M, CHO C Y. Apparent digestibility of rendered animal protein ingredients for rainbow trout (*Oncorhynchus mykiss*) [J]. *Aquaculture*, 1999, 180: 345-358.
- [38] TERRAZAS-FIERRO M M, AVILA-GONZALEZ E, CUCA-GARCIA M. Effect of over processed fish meal in diet formulation for broilers according to digestible amino acid basis [J]. *Técnica Pecuaria en México*, 2005, 43: 297-308.
- [39] DONG F M, HARDY R W, HARD N F, et al. Chemical composition and protein digestibility of poultry by-product meals for salmonid diets [J]. *Aquaculture*, 1993, 116: 149-158.
- [40] ALLAN G L, PARKINSON S, BOOTH M A, et al. Replacement of fish meal in diets for Australian silver perch, *Bidyamus bidyamus*: 1. Digestibility of alternation ingredients [J]. *Aquaculture*, 2000, 186: 293-310.
- [41] LUO Z, TAN X Y, CHEN Y D, et al. Apparent digestibility coefficients of selected feed ingredients for Chinese mitten crab *Eriocheir sinensis* [J]. *Aquaculture*, 2008, 285: 141-145.
- [42] LALL S P. Digestibility, metabolism and excretion of dietary phosphorus in fish // COWEY C B, CHO C Y. Proceedings of the first international symposium on symposium on nutritional strategies and management of aquaculture waste. Ontario: University of Guelph, 1991: 21-36.
- [43] 梁丹妮, 姜雪姣, 刘文斌, 等. 建鲤对6种非常规蛋白质原料中营养物质的表观消化率 [J]. *动物营养学报*, 2011, 23(6): 1065-1072.
- [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] 杨俊, 王之盛, 保善科, 王威, 薛白, 张海波, 邹华围. 精料补充料能量水平对早期断奶犊牛生产性能和营养物质表观消化率的影响 [J]. *动物营养学报*, 2013, 25(9): 2021-2027
- [3] 刘志, 张铁涛, 郭强, 吴学壮, 高秀华, 杨福合, 邢秀梅. 饲料铜水平对育成期蓝狐生长性能、营养物质消化率及氮代谢的影响 [J]. *动物营养学报*, 2013, 25(7): 1497-1503
- [4] 耿梅, 姜建阳, 韩先杰, 宋春阳. 纤维素组合酶在不同品种生长猪饲料中的适宜添加量 [J]. *动物营养学报*, 2013, 25(7): 1541-1550
- [5] 李世召, 支丽慧, 杨小军, 姚军虎. 种蛋注射在家禽营养表观遗传学上的应用 [J]. *动物营养学报*, 2013, 25(6): 1169-1173
- [6] 张拴林, 袁霞, 徐亚光, 聂玉梅, 武晋孝, 程建国, 杨致玲, 黄应祥. 硒和维生素E对肉牛养分表观消化率、氮平衡、能量代谢及血液生化指标的影响 [J]. *动物营养学报*, 2013, 25(6): 1219-1228
- [7] 穆国柱, 李福昌, 王雪鹏, 王春阳, 吴振宇. 饲料豆油添加水平对断奶至3月龄獭兔生长性能、营养物质消化代谢、血清生化指标及皮毛质量的影响 [J]. *动物营养学报*, 2013, 25(6): 1375-1382

- [8] 刘群芳, 曹俊明, 黄燕华, 王国霞, 文远红, 周婷婷, 孙智武, 刘小玲.  $\beta$ -葡聚糖与硒、维生素E联合添加对凡纳滨对虾组织生化指标及免疫、抗氧化相关酶mRNA表达的影响[J]. 动物营养学报, 2013,25(5): 1045-1053
- [9] 刘佰阳, 李光玉, 鲍坤, 刘晗璐, 李丹丽, 顾东, 张涛. 棉籽低聚糖对水貂生长性能、营养物质消化代谢、肠道菌群和免疫性能的影响[J]. 动物营养学报, 2013,25(5): 1123-1130
- [10] 杨奇慧, 谭北平, 董晓慧, 迟淑艳, 刘泓宇, 王凤美. 铬对凡纳滨对虾生长性能、血清生化指标及非特异性免疫酶活性的影响[J]. 动物营养学报, 2013,25(4): 795-804
- [11] 赵珩伊, 余冰, 毛湘冰, 何军, 郑萍, 黄志清, 韩国全, 虞洁, 陈代文. 水合硅铝酸钠钙对生长肥育猪生长性能、养分表观消化率及抗氧化能力的影响[J]. 动物营养学报, 2013,25(3): 571-578
- [12] 张立涛, 李艳玲, 王金文, 崔旭奎, 孟宪锋, 屠焰, 刁其玉. 不同中性洗涤纤维水平饲料对肉羊生长性能和营养成分表观消化率的影响[J]. 动物营养学报, 2013,25(2): 433-440
- [13] 杨桂芹, 郭东新, 李闯, 孙亮, 田河, 李建涛. 稻草和豆秸在肉兔上的表观消化能和营养物质表观消化率的评定[J]. 动物营养学报, 2013,25(11): 2689-2695
- [14] 陈颖, 朴香淑, 赵泮峰, 曾志凯. 评估L-蛋氨酸的有效性及其标准回肠可消化蛋氨酸水平对断奶仔猪生长性能、营养物质表观消化率及血浆参数的影响[J]. 动物营养学报, 2013,25(10): 2430-2439
- [15] 钟伟, 刘风华, 赵靖波, 张铁涛, 常忠娟, 鲍坤, 张海华, 徐超, 王夕国, 李光玉. 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[J]. 动物营养学报, 2013,25(10): 2489-2496