

研究一 脂肪成分 (Component) 對生長及肥育豬對脂肪利用之影響

- 粒狀單酸甘油酯用于肉豬飼料可行性之研究

摘要

本研究分為消化及飼養試驗，探討提高脂肪粉中單酸甘油酯，不同碘價或游離脂肪酸 (free fatty acid; FFA) 比例及添加卵磷脂，對生長及肥育豬對脂肪消化率、消化能、豬糞性狀、生長性能及屠體性狀之影響。消化試驗包括 3 個試驗，各以 4 頭雜交閹公豬，分別於生長 (30 公斤) 及肥育期 (70 公斤) 進行 4 × 4 拉丁方格試驗，分別餵飼含有 8%天然脂肪或脂肪粉之試驗飼糧 (試驗一：棕櫚油、SL、MGL 及 FMGL；試驗二：玉米油、牛油、FMG 及 FMGL；試驗三：IV15FFA25、IV15FFA75、IV25FFA25 及 IV25FFA75；其中 S：硬脂，MG：單酸甘油酯，L：卵磷脂，F：高游離脂肪酸，IV：碘價；FFA：游離脂肪酸百分率)。以全糞收集法測定脂肪來源之表面及真消化率及消化能。飼養試驗以 56 頭 44 公斤雜交豬，分成 4 處理組，每處理 4 重複，每重複 3 或 4 頭，分別餵飼含有 5%牛油、SL、FMG 及 FMGL 之試驗飼糧。試驗期間，記錄豬隻體重及飼料採食量，計算每日增重及飼料利用效率，至體重 110 kg 時犧牲，測定豬隻屠宰率、背脂厚度及腰眼面積，並計算屠體瘦肉率。試驗結果顯示，將 SL 製成含 50%MG 之 MGL，可提高脂肪消化率 ($P < 0.05$)；進一步添加 FFA 至 25%

(FMGL), 可提高脂肪消化率及消化能 ($P < 0.05$), 並減少糞中殘留之脂肪粉顆粒; FMGL 中不添加 6% 卵磷脂 (FMG), 對脂肪酸消化率及消化能並無影響; 提高 FMGL FFA 比例至 75% (FFA75), 降低脂肪消化率及消化能 ($P < 0.05$); 提高 FMGL 之 IV, 提高高 FFA (FFA75) 組之脂肪消化率及消化能 ($P < 0.05$)。將 SL 製成 FMG, 可提高肥育豬平均每日增重及飼料利用效率 ($P < 0.05$), 且與牛油相當。FMG 組豬隻比牛油組具較低的背脂厚度 ($P < 0.05$)。進一步添加 6% 卵磷脂 (FMGL), 對肥育豬生長性能及屠體性狀並無影響。綜合以上, 將 SL 製成 IV15 FFA25 之 FMGL, 可獲得最佳之效果; 與 SL 相較, 可提高脂肪消化率、消化能及肥育豬每日增重, 並改善飼料利用效率。

關鍵語：硬脂、單酸甘油酯、脂肪消化率、生長性能、屠體性狀、豬

結論

綜合在生長及肥育豬生長性能、屠體性狀、脂肪消化率、豬糞性狀、糞中是否殘留脂肪粉顆粒及產品保存性之試驗結果，將硬脂 (SL) 製成 IV15 並含 25%FFA 之粒狀單酸甘油酯 (IV15 FFA25 組)，可獲得最佳之效果。IV15 FFA25 與 SL 相較，可提高脂肪消化率及消化能含量；並提高肥育豬每日增重及改善飼料利用效率。

Study 1 Effect of Fat Component on the Utilization of Fat in Growing and Finishing Pigs - Application of the Stearin Monoglyceride Powder in Diets of Pigs

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Abstract

The study included digestibility and feeding trials for investigating the effects of increasing of monoglyceride, iodine value and free fatty acids and lecithin supplementation of powder stearin on fat digestibility and digestible energy (DE), fecal appearance, growth performance and carcass characteristics in growing and finishing pigs. Three digestibility trials were conducted, four crossbred barrows were allotted to treatments in 4×4 Latin square design in each trial during growing (30 kg) or finishing (70 kg) period. Pigs were fed diets containing 8% of natural fat or fat powders [trial 1: palm oil, SL, FMG or FMGL; trial 2: corn oil, tallow, FMG or FMGL; (S: stearin, MG: monoglyceride, L: lecithin, F: high free fatty acids) trial 3: FMGL with IV15FFA25, IV15FFA75, IV25FFA25 or IV25FFA75 (IV: iodine value; FF: free fatty acid, %)]. Total feces were collected for measuring the apparent and true digestibility and DE of fat sources. In feeding trial, fifty six crossbred barrows with 44 kg were assigned to 4 treatments, 4 replicates per treatments, and 3 or 4 pigs per replicate. Pigs were fed diets containing 5% of tallow, SL, FMG or FMGL until they reached 110 kg. Average daily gain (ADG), feed intake, gain/feed and carcass characteristics were measured. Results showed that, increasing MG (MGL) increased fat digestibility of SL ($P < 0.05$). Increasing FFA to 25% (FMGL) increased fat digestibility and DE of SL ($P < 0.05$), and decreased residual fat powder in feces. Lecithin supplementation did not affect fat digestibility and DE of MG. Increasing FFA of FMGL to 75% (FFA75) decreased fat digestibility and DE of FMGL ($P < 0.05$). Increasing IV increased fat digestibility and DE of high FFA FMGL (FFA75) ($P < 0.05$). Manufacturing SL to FMG improved the ADG and gain/feed, and decreased backfat thickness of finishing pigs. Lecithin supplementation (FMGL) had no effect on growth performance and carcass characteristics of finishing pigs. FMG maintained similar growth performance and thinner backfat of finishing pigs than those of tallow.

In conclusion, fat powder containing 50% MG and 25% FFA, and with IV of 15 had highest fat digestibility and DE, and growth performance and carcass characteristics in finishing pigs.

Key Words: Stearin, Monoglyceride, Fat digestibility, Growth performance, Carcass characteristics, Pigs.

研究二 脂肪酸位置分佈對肉雞生長性能、脛骨性狀及脂肪消化率之影響

摘要

本研究之目的在於探討三酸甘油酯之脂肪酸位置分佈對肉雞對生長性能、脂肪及鈣之表面及真全腸道及迴腸消化率、脛骨性狀及跛腳率之影響。研究分為消化及飼養兩個試驗，消化試驗以 30 隻體重相近之愛拔益加公雛肉雞，逢機分配至 2×3 複因子設計之處理組中，每處理 5 重複，個別飼養於溫控室之代謝籠內。試驗飼糧含 10% (0-3 週) 及 8.7% (4-6 週) 脂肪，分別為兩種飽和脂肪酸 (saturated fatty acids; SFA) 於甘油第二個碳 (*sn-2*) 比例 (16 及 52%) 及三種鈣含量 (0-3 週: 1.20, 1.00 及 0.80% ; 4-6 週: 1.08, 0.91, 0.72%)，另取 8 隻公雛肉雞個別飼養於代謝籠，分別餵飼無脂或無鈣飼糧，測定內源性脂肪及鈣。測定雞隻脂肪及鈣之表面及真全腸道消化率。飼養試驗以 600 隻 1 日齡愛拔益加公雛肉雞，逢機分配至 3 處理組，每處理 8 重複，每重複 25 隻，飼養於開放式平飼雞舍。試驗飼糧含 10% (0-3 週) 及 8.7% (4-6 週) 脂肪，其中 SFA *sn-2* 比例，分別為 16 及 30 % (0-3 週) 及 21 及 32 % (4-6 週) 及棕櫚油組 (*sn-2* SFA 比例約 9%)。測定雞隻之生長性能、脛骨性狀及脂肪及鈣之表面及真迴腸消化率。試驗

結果顯示，提高飼糧 *sn*-2 SFA 比例 (HS 組)，可提高肉雞對脂肪表面及真全腸道及迴腸消化率、脛骨破裂強度、應力、骨鈣含量、腹脂 C16:0 及 SFA 含量，並降低跛腳率 ($P < 0.05$)。提高飼糧中鈣含量，會降低肉雞對鈣表面及真全腸道消化率 ($P < 0.01$)。肉雞之鈣表面及真全腸道及迴腸消化率、生長性能、腹脂重及死亡率，則不受飼糧脂肪酸位置分佈之影響。棕櫚油組之總脂肪酸及 SFA 表面及真迴腸消化率與 HS 組相當，但較 LS 組高 ($P < 0.05$)。綜合以上，提高飼糧中 *sn*-2 SFA 比例，提高肉雞對脂肪之消化率，改善腿部骨骼發育，並降低跛腳率。

關鍵語：脂肪酸位置分佈、生長性能、脛骨性狀、脂肪消化率、肉雞

結論

提高飼糧 *sn-2* SFA 比例，可提高肉雞對脂肪酸及鈣消化率、脛骨破裂強度、應力及骨鈣含量，並降低跛腳率。惟肉雞之生長性能、腹脂重及死亡率，則不受飼糧脂肪酸位置分佈之影響。豬油之 *sn-2* SFA 較牛油高，較有利於肉雞對脂肪酸及鈣之消化率及骨骼發育。棕櫚油之 *sn-2* SFA 最低，最為不利。

Study 2 Effect of Positional Distribution of Fatty Acids on Growth Performance, Tibia Characteristics and Fat Digestibility in Broilers

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Abstract

Two experiments (digestibility and feeding trials) were conducted to investigate the effect of positional distribution of fatty acids in dietary triglycerides on growth performance, apparent and true fecal and ileal fat and calcium digestibility, tibia characteristics and leg abnormalities in broilers. 30 Arbor Acres 1-day old male chicks were allotted to 6 treatments and fed diets with two levels of *sn*-2 saturated fatty acids (SFA) % (16 and 52) and 3 levels of calcium (0-3 week: 1.20, 1.00, and 0.80%; 4-6 week: 1.08, 0.91 and 0.72%) in a 2 × 3 factorial design with five replicates. Chicks were reared in wire-flooded metabolism cages in temperature-controlled chambers and offered 10% (0-3 week) or 8.7% (4-6 week) fat-containing diets. Another 8 chicks were reared in wire-flooded metabolism cages individually and offered fat-free diet or Ca-free diet to determine endogenous fat and Ca secretion. Apparent and true fecal digestibility of fat and calcium were measured. 400 Arbor Acres 1-day old male chicks were allotted to 3 treatments with two levels of *sn*-2 SFA % (week 0-3: 16 and 30%; week 4-6; 21 and 32%) or palm oil (*sn*-2 SFA is about 9%), 8 replicates per treatment, and 25 chicks per replicate. Chicks were reared in floor pen and offered 10% (0-3 week) or 8.7% (4-6 week) fat-containing diets. Growth performance, tibia characteristics and apparent and true ileal digestibility of fat and calcium were measured. Results showed that increasing dietary *sn*-2 SFA % increased fat digestibility, force, stress and calcium content of tibia, C16:0 and SFA content of abdominal fat ($P < 0.05$), and decreased leg abnormalities in broilers ($P < 0.05$); increasing dietary calcium decreased calcium digestibility ($P < 0.01$). Increasing dietary *sn*-2 SFA % did not affect apparent and true fecal digestibility of calcium, growth performance, weight of abdominal fat and mortality of broilers. Apparent and true ileal digestibility of fat and SFA of palm oil was higher than LS ($P < 0.05$), but as the same as the ones of HS.

In conclusion, increasing dietary *sn*-2 SFA % could improve fat digestibility and leg development, and decrease the leg abnormality in

broilers.

Key Words: Positional distribution of fatty acids, Growth performance, Tibia characteristics, Fat digestibility, Broilers