The effect of the dietary inclusion of canola oilcake, full-fat canola and sweet lupins on the production performance and fat composition of broilers and pigs

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Abstract

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The demand for protein for human and animal nutrition in South Africa is increasing and it will continuously increase. The effect of replacing soybean oilcake meal as protein source for broilers and full-fat soybean meal for weaner pigs, with different levels of sweet lupins (*Lupinus angustifolius*), canola oilcake and full-fat canola was examined. A basal diet with soybean oilcake as protein source was mixed with a diet using either sweet lupins or canola oilcake or full-fat canola in ratios of 100%, 67% and 33% respectively. In the broiler trial the test diets were fed for a period of six weeks with or without the enzyme Vegpro (Alltech). Pigs were fed the test diets, with and without Roxazyme® enzyme, *ad libitum* from 8.5 to 25 kg live weight. The fatty acid content of the fat pads of the broilers raised on the different diets was determined. The pigs were kept in the trial up to the grower- finisher phase. The fatty acid content of the carcass fat and muscle of pigs raised on the different diets was determined. The inclusion of enzymes had no effect on the growth, feed intake or feed conversion ratio of broilers fed the test diets. The provision of external dietary enzymes to the weaner pig diets failed to improve either dry matter intake or growth rate, but improved the feed conversion ratio. Broiler weights at six weeks of age were significantly higher for the control diet compared to the 20% lupin diet. There was no significant difference in the feed intake as the lupin content of the diets increased. The feed conversion ratio did not differ significantly between the control diet and the 6.6% lupin diet but became significantly poorer as the lupin content increased to 13.2% and 20% of the test diet. There were no significant differences in production performance of the control diet and the canola oilcake containing diet. The broiler weights at six weeks decreased significantly with each increase in the canola oilcake content of the diets. The feed intake of the 20% canola oilcake diet at week six was significantly less than the intake of the control diet, but not significantly less than the 6.6% and 13.2% canola oilcake diets. The feed conversion ratio of the control diet was significantly better than the 13.2% and 20% canola oilcake diets. No significant differences were found in week six between the 6.6% full-fat canola diet and the control diet for broiler weights and feed intake. The feed conversion ratio of the broilers fed the 13.2% and 20% full-fat canola diets was significantly poorer than the control diet. The final body weights of the weaner piglets fed the control

diet were significantly higher than the final body weights of weaner piglets fed the lupin containing diets. The average daily gain of the weaner piglets fed the control diet was significantly higher than the gain of the weaner piglets fed the lupin containing diets. No significant differences in the feed intake and feed conversion ratio between the different lupin inclusion levels were detected. There were no significant differences in body weight, feed intake, average daily gain and the feed conversion ratio, between the various full-fat canola containing diets and the control diet. A significant difference in body weight was found between the weaner piglets fed the 20% canola oilcake diet and the weaner piglets fed the control diet. There were no significant differences in feed intake between the various inclusion levels of canola oilcake. The control and 6.6% canola oilcake containing diets had significantly higher average daily gains than the 20% canola oilcake containing diet. In the final trial the finisher pigs fed the test diet containing 25.00% lupins, had a final body weight significantly lighter than the final body weight of the finisher pigs fed the other test diets. The finisher pigs fed the test diet containing 25.00% lupins, also had a significantly reduced average daily gain and feed intake. The feed intake of the 25.00% canola oilcake diet was significantly lees than the feed intake of the 16.75% full-fat canola containing diet. The feed conversion ratio of the 25.00% lupin containing diet was significantly poorer than the feed conversion ratio of the 16.75% lupin containing diet, 8.25% lupin containing diet, 16.75% full-fat canola containing diet, 25.00% canola oilcake containing diet and the control diet.

In a choice feeding trial growing pigs were offered four diets with four different protein sources: sweet lupins (25% inclusion level), canola oilcake (25% inclusion level), full-fat canola (25% inclusion level) and soybean oilcake (25% inclusion level), while their daily intakes were recorded. In a second choice feeding trial pigs were offered ten different diets with increasing levels (6.6%, 13.2%, 20%) of either sweet lupins, canola oilcake meal or full-fat canola meal. The pigs consumed significantly more of the soybean oilcake containing diet compared to diets containing the alternative protein sources. Pigs consumed significantly less of the full-fat canola diet compared to the sweet lupin and canola oilcake diets.

Ten different canola cultivars were collected from two different locations in the Mediterranean rainfall area of South Africa namely the Western Cape (Swartland) and Southern Cape (Riens) grain producing areas. The sinapine and glucosinolate content of various canola cultivars was compared and the influence of locality on the sinapine and glucosinolate content of the canola cultivars was determined. There were no significant differences ($P \leq 0.05$) in sinapine content when the canola produced in the Western and Southern Cape were compared. Varola 54 and Rainbow cultivars had significantly higher ($P \leq 0.05$) sinapine contents compared to the Varola 50 cultivar.

Samples of lupins, field peas, faba beans and narbon beans were collected and analysed for amino acids, alkaloids, non-starch polysaccharides, tannin and starch. The digestible energy value of these alternative protein sources for pigs was determined. Significant differences were found in the amino acid content of the various crops. The alkaloid content of the lupins varied significantly between the sweet and bitter lupin varieties. Sweet *L. angustifolius* cultivars contained *ca* 50mg/kg and the bitter *L. angustifolius*

cultivars *ca* 15000mg/kg alkaloids. The mean alkaloid content of *L. albus* cultivars was *ca* 1300mg/kg. The faba beans, narbon beans and peas had significantly higher values for tannins and starch, compared to lupins.

Opsomming

Titel:	Die invloed van kanola oliekoek, volvet kanola en soet lupiene, insluiting in diëte, op die produksie en vetsuur profiele van braaikuikens en varke
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In Suid-Afrika is daar 'n toenemende vraag na proteïene vir beide menslike- en dierlike gebruik. Die gebruik van soet lupiene (*Lupinus angustifolius*), kanolaoliekoek en volvetkanola is ondersoek vir die vervanging van sojaboonoliekoekmeel en volvetsojaboonmeel as proteïenbron by braaikuikens en speenvarkies. 'n Basiese dieet, met sojaboonoliekoek as proteïenbron, is gemeng met die alternatiewe proteïenbronne, soet lupiene (*Lupinus angustifolius*), kanolaoliekoek en volvetkanola , om drie toetsdiëte met insluitingsvlakke van 100%, 67% en 33% te verkry. In die braaikuikenproef is die braaikuikens vir ses weke met of sonder die ensiem Vegpro (Alltech) gevoer. Die speenvarkies is *ad libitum* gevoer, met of sonder die ensiem Roxazyme, van 8.5 tot 25 kg lewendige gewig.

Die vetsuurinhoud van die borsvet by braaikuikens is op die verskillende diëte is bepaal. Die speenvarkies is tot afronding gehou op bogenoemde diete, waarna vetsuurprofiele van die karkasvet en vleis bepaal is. Die insluiting van ensieme het geen effek op groei, voerinname of voeromsetverhouding by die braaikuikens gehad nie, ongeag die proteïenbron in die dieet. Die byvoeging van eksterne ensieme by die speenvarkdiëte het nie die droë material inname of groei beïnvloed nie, maar het wel die voeromsetverhouding vebeter. Op ses weke ouderdom, was die braaikuiken gewigte van die kuikens wat die 20% lupien diet ontvang het betekenisvol laer as die kontrole diet. Die lupien insluiting het geen betekenisvolle verskille in die voerinnam van die braaikuikens veroorsaak nie. Daar was geen betekenisvolle verskil tussen die voeromsetverhouding van die braaikuikens wat die kontrole diet en die 6.6% lupien diet ontvang het nie, die voeromsetverhouding het egter verswak soos die lupien insluiting hoer geword het. Die braaikuiken gewigte het betekenisvol gedaal soos die kanolaoliekoek insluiting meer geword het. Die voerinname van die 20% kanolaoliekoek diet op ses weke ouderdom was betekenisvol minder as die kontrole diet, maar nie betekenisvol minder as die ander kanolaoliekoek bevattende diete nie. Die voeromsetverhouding van die kontrole diet was betekenisvol beter as die 13.2% en die 20% kanolaoliekoek diete. Daar was geen betekenisvolle verskille in die braaikuiken gewigte en die voerinname, tussen die 6.6% volvetkanola diet en die kontrole diet nie. Die voeromsetverhouding van die braaikukens wat die 13.2% en

die 20% volvetkanola diete ontvang het was betekenisvol laer as die kontrole diet. Die finale liggaams massa en gemiddelde daaglikse toename van die speenvarkies wat die kontrole diet ontvang het was betekenisvol hoer as die van die speenvarkies wat die lupien diete ontvang het. Daar was geen verskille in die voerinname en voeromsetverhouding tussen die verskillende lupien insluitingsvlakke nie. Daar was geen betekenisvolle verskille in die laggaams massa, voerinname, gemiddelde daaglikse toename en voeromsetverhouding, tussen die verskillende volvetkanola diete en die kontrole diete. Daar was 'n betekenisvolle verskil in die ligaams massa tussen die speenvarkies wat die 20% kanola oliekoek diet ontvang het en die speenvarkies wat die kontrole diet ontang het. Geen betekenisvolle verskille is gevind in die voerinname van die kanolaoliekoek diete en die kontrole diet nie. Die speenvarkies wat die kontrole diet en die 6.6% kanolaoliekoek diet ontvang het, het betekenisvolle hoer gemiddelde daaglikse toename gehad as die speenvarkies wat die 20% kanolaoliekoek diet ontvang het. In die finale proef het die varke wat die 25% lupien diet ontvang het,'n betekenisvol ligter liggaams massa asook 'n laer gemiddelde daaglikse toename en laer voerinname gehad as die varke wat die ander toets diete ontvang het. Die voeromsetverhouding van die varke wat die 25%lupien diet ontvang het ewas ook betekenisvol swakker as die ander toets diete.

In 'n volgende proef met groeiende varke, het die varke 'n vrye keuse tussen vier diëte met vier verskillende proteïenbronne gehad. Die proteïenbronne was: sojaboonoliekoekmeel, soet lupiene (*Lupinus angustifolius*), kanolaoliekoek en volvetkanola. Die varke se daaglikse voerinnames is aangeteken. In 'n tweede proef het die varke 'n vrye keuse tussen tien diëte gehad, die diëte het soet lupiene, kanolaoliekoek en volvetkanola teen drie insluitings peile bevat (6.6%, 13.2% en 20%) . Die varke het aanvanklik meer van die sojaboonoliekoekdieet ingeneem as die ander diëte. Die varke het die minste van die volvetkanoladieet ingeneem, in vergelyking met die inname van die soet lupiene- en kanolaoliekoek diëte.

Tien kanola kultivars is versamel by twee lokaliteite, Swartland (Wes-Kaap) en Ruens (Suid-Kaap), in die Westelike provinsie van Suid-Afrika. Die sinapien- en glukosinolaatinhoud van die verskeie kanola kultivars is met mekaar vergelyk en die invloed van lokaliteit op die sinapien- en glukcosinolaatinhoud van die kanola kultivars is bepaal. Daar was geen betekenisvolle verskil ($P \leq 0.05$) in die sinapieninhoud tussen die kanola wat in die Wes-en Suid-Kaap geproduseer is nie. Varola 54 en Rainbow kultivars het meer sinapiene bevat as die Varola 50 kultivar.

Lupien-, voererte-, fababoon- en narbonboonmonsters is versamel en die aminosuur-, alkaloïed-, nie-stysel poliesakkaried-, tannien- en styselinhoud is bepaal. Die verteerbare energie waarde van hierdie alternatiewe proteïenbronne vir varke is bepaal. Betekenisvolle verskille is gevind in die aminosuurinhoud van die verskeie proteïenbronne. Die alkaloïedinhoud van die lupiene het betekenisvol verskil tussen die soet- en bitter lupien variëteite. Soet (*L. angistifolius)* kultivars het ongeveer 50mg/kg en bitter (*L. angistifolius*) kultivars het ongeveer 15000mg/kg alkaloïede bevat. Die gemiddelde alkaloïed inhoud van die *L. albus* kultivars was ongeveer 1300mg/kg. Die tannien- en styselinhoud van die fababone, narbonbone en voer-erte was betekenisvol hoër as die van lupiene.