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# Effects of fermented oyster mushroom (*Pleurotus ostreats*) by-product supplementation on growth performance, blood parameters and meat quality in finishing Berkshire pigs

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*The objective of the present study was to investigate the effects of fermented oyster mushroom (Pleurotus ostreats) by-production (FOMP) supplementation on the growth performance, blood parameters, carcass traits and meat quality in finishing Berkshire pigs. FOMP was made by mixing oyster mushroom by-production with rice bran and barley bran and this mixture was fermented for 60 days. The experimental diets were 0, 3, 5 and 7% of FOMP added to C, T1, T2 and T3 in the basis diet for 7 weeks. Average daily gain (kg/day) was higher in C and T1 than in T2 and T3 ($P < 0.05$). Average daily feed intake (kg/day) and feed conversion increased by the addition of FOMP ($P < 0.05$). Total cholesterol and high-density lipoprotein cholesterol were higher in T3 than other treatments ($P < 0.05$). Carcass weight (kg) was higher in C and T1 than in T2 and T3 ($P < 0.05$). Dressing (%) was higher in C than in T3 ($P < 0.05$). Crude protein was lower in T3 than in other treatments ($P < 0.05$). Crude fat was higher in T2 and T3 than in C ($P < 0.05$). $pH_{24}$ was higher in C than in other treatments ($P < 0.05$). Cooking loss (%) was higher in T1 than T2 ($P < 0.05$). Water-holding capacity (%) was higher in C than in T1 ($P < 0.05$). In meat colour, CIE a* was lower by the addition of FOMP ($P < 0.05$). CIE b* was higher in C than in other treatments ($P < 0.05$). In backfat colour, CIE L* was lower in T3 than other treatments ($P < 0.05$). CIE b* was lower by addition of FOMP ($P < 0.05$). Palmitoleic and oleic acid were higher in T3 than in other treatments ($P < 0.05$). Linoleic and arachidonic acids were higher in T2 than in other treatments ($P < 0.05$). The results indicate that 3% of FOMP affected the growth performance, carcass traits, meat quality and fatty acid in contrast to addition of 5% of FOMP for Berkshire pigs during the finishing period.*

**Keywords:** carcass composition, growth, meat quality, oyster mushroom by-production, pigs.

## Introduction

Oyster mushrooms are macroscopic fungi, which are traditionally used as Chinese medicines or functional food in Asian countries (Kawagishi *et al.*, 2000). Oyster mushrooms have a high quantity of proteins, carbohydrates, minerals and vitamins as well as low fat (Manzi *et al.*, 1999). Edible mushrooms have several beneficial effects on health such as hypoglycaemic activities (Wang and Ng, 1999), and produce. Mushrooms also produce proteins such as lectins, ribosome-inactivating proteins, antifungal proteins and ribonucleases (Kobayashi *et al.*, 1992; Lam and Ng, 2001; Ye and Ng, 2002; Wang *et al.*, 2002). Many researchers have reported that mushrooms are an ideal food for the dietetic prevention of atherosclerosis due to their high content of fibre, protein and low fat content (Kurasawa *et al.*, 1982; Wong *et al.*, 2003; Cheung and Lee, 2000). In their work, Sun *et al.* (1984) used mushrooms as natural hypocholesterolemic and antisclerotic diet in oriental medicine. Mushrooms have also be found to be medically active in several therapies such as antitumour, antiviral, and immunomodulating treatments (Wasser and Weis, 1999) and in retarding the increase in cholesterol in serum (Bobek *et al.*, 1991 and 1998; Chenug, 1998).

Many researchers have worked on the biological activities and medicine of oyster mushroom. However, there are few works on use of oyster mushrooms by-products as supplements in animal diets. The objective of this study was to investigate the effect of supplementation with fermented oyster mushrooms by-products (FOMP) on the growth performance, blood parameters, carcass traits and meat quality in Berkshire pigs.

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## Material and methods

### *Animals and diets*

One hundred and twenty Berkshire pigs were used. They were randomly allocated 71 ± 1.7 kg body weight (about 135 days of age) into 12 pens with 10 pigs per pen (4.0 m × 6.0 m pens with solid concrete flooring) in a front-open building with three replicate pens per treatment. They were not separated by sex (gilt, barrow and the males castrated) but the ratio of the sexes was similar in each allotment.

FOMP was made by mixing oyster mushroom by-product with rice bran and barley bran and this mixture was fermented for 60 days. The moisture contents of the ingredients were adjusted to about 60% by adding water. Ingredients were mixed in fresh condition in 600-l plastic containers in the ratio of 50% oyster mushroom by-product, 25% rice bran and 25% barley bran. FOMP was produced in the form of pellets and this diet was dried to 12% of moisture at room temperature. The experimental diets were 0, 3, 5 and 7% of FOMP added to C, T1, T2 and T3 (C- control, T- treatment) in the basic diets for 7 weeks respectively. The pigs had *ad libitum* access to water and diets. The ingredients and chemical composition of the basic diets used in this experiment are shown in Table 1. All other nutrient requirements met or exceeded that of National Research Council (1998) for finishing pigs. The chemical composition of FOMP is shown in Table 2. The live weights of pigs and feed consumption were measured to calculate average daily gain (ADG) and average daily feed intake (ADFI). The feed convention ratio (FCR) was calculated from ADG and ADFI.

### *Blood parameters*

Blood samples were collected from the jugular vein of the sows by venipuncture. It was collected 3 h after feeding on the last experimental day.

The number of the leukocytes ($10^3/\mu l$) and erythrocytes ($10^6/\mu l$), haemoglobin (g/μl), haematocrit (%), platelet ($10^3/\mu l$), mean corpuscular volume (MCV, μl), mean corpuscular hemoglobin (MCH, pg) and mean corpuscular haemoglobin concentration (MCHC, g/μl) were determined using an automatic haematological analyser (VET abc, France) within 2 h after blood sampling.

For the analysis of biochemical composition of plasma, blood samples were separated by centrifuging for 15 min at 2000 r.p.m., and the plasma was then analysed for total cholesterol (mg/μl), high-density lipoprotein cholesterol (HDL, mg/μl), low-density lipoprotein cholesterol (LDL, mg/μl), total protein (g/μl) and blood urea nitrogen (BUN, mg/μl) by Express Plus (Bayer, USA).

### *Carcass traits and chemical composition*

Pigs of 103 ± 3 kg live weight were transported to a normal abattoir near the experimental station. The pigs were slaughtered 12 h from the time of food withdrawal. They were stunned electrically (300 V for 3 s) with a pair of stunning tongs, shackled by the right leg and exsanguinated while hanging. Carcasses were then placed in a dehairer at 62°C for 5 min and the hair that remained was removed after exit from the dehairer using a knife and flame. Carcasses were then eviscerated and split before being placed in a chiller set at 5°C for 12 h. Dressing percentage was calculated as the ratio of cold carcass weight

**Table 1** *Ingredient composition and chemical composition of the control diets (as-fed basis, %)*

| Ingredients | Finisher |
|---|---|
| Maize | 51.51 |
| Wheat-12% | 15.00 |
| Wheat bran | 6.00 |
| Soya-bean meal 44% | 0.52 |
| Molasses | 16.44 |
| Fat animal | 4.00 |
| Calcium phosphate 18% | 3.80 |
| Limestone | 1.00 |
| Salt 98% | 1.00 |
| $CuSO_4$(Cu-10%) | 0.32 |
| Methionine (SYST) 50% | 0.01 |
| Lysine (SYST) 98% | 0.16 |
| Mix-vitamin[†] | 0.08 |
| Mix-mineral[‡] | 0.08 |
| Etc | 0.09 |
| Total | 100.00 |
| Chemical composition (%)[§] | |
| Dry matter | 87.44 |
| Crude protein | 14.53 |
| Crude fat | 6.27 |
| Crude fibre | 3.06 |
| Crude ash | 4.97 |
| Calcium | 0.82 |
| Phosphorus | 0.50 |
| Total lysine | 0.80 |
| Total methionine | 0.24 |
| Total methionine + cysteine | 0.50 |
| Total threonine | 0.53 |
| Total tryptophan | 0.16 |
| Digestible energy (kJ/kg) | 827.04 |

[†] Supplied in mg/kg diet: retinol 2400; cholecalciferol 37.5; alpha-tocopherol 40 000; phytylmenaquinone 1500; thiamine 1000; riboflavin 4000; cyanocobalamin 20 000; pyridoxine 2000; niacin 20 000; biotin 30; folic acid 600.
[‡] Supplied mg/kg diet: Se 250; I 200; Fe 60 000; Mn 25 000; Zn 60 000; Cu 15 000.
[§] Chemical composition was calculated from ingredient proportion.

**Table 2** *The chemical composition of fermented oyster mushroom by-production used in the experiment*

| | Content (%) |
|---|---|
| Moisture | 9.25 |
| Crude protein (DM) | 17.61 |
| Crude fat (DM) | 11.07 |
| Crude fibre (DM) | 9.40 |
| Crude ash (DM) | 17.92 |
| Gross energy (kJ/kg) | 1117.30 |



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to live weight after fasting. Backfat thickness at the 10th rib (three-quarters distance along the *longissimus dorsi* muscle (LM) toward the belly) was measured.

For the determination of chemical compositions and meat quality parameters, the LM (6th to 13th rib) was cut off and kept at 4°C, and then transported to the laboratory. Among chemical compositions, the concentrations of moisture, crude protein, crude fat and crude ash in samples of LM were determined according to the Association of Official Analytical Chemists (1995) about 24 h after slaughter.

*Meat quality*

For measurement of $pH_{24}$, a 2-g sample of LM was homogenised at about 24 h *post mortem* in 10 volumes of distilled water using a polytron homogeniser (MSE, USE). pH was measured using a Hanna HI 9025 pH meter (Woonsocket, RI) with an Orion 8163 glass electrode (Berverly, MA). Cooking losses were determined as described by Honikel (1998). Water-holding capacity (WHC) was determined by a centrifugal method as followed by Jauregui *et al.* (1981). Meat and backfat colour of LM was evaluated on a freshly cut surface (3 μm thick slice) using a Minolta chromameter CR-300 (Minolta, Japan) (D65/10̊) after placing for 20 min at room temperature. The average of five replicates were expressed as CIE L*, a* and b*.

For the determination of fatty acids in LM, extracted fat sample was prepared from LM after meat quality parameters were estimated. Meat fat was extracted from the ground muscle using a modification of the Folch wash method as described by Ways and Hanrahan (1964). Fatty acids were quantified as their fatty acid methyl esters (FAME), and prepared by acid catalysed methanolysis (Stanton *et al.*, 1997). The FAMEs in the hexane layer were analysed on an Agilent chromatograph (Agilent-6890 +, USA) with a mass spectrometry (MS) detector and split (50:1) injector. The samples were methylated in duplicate and were injected twice onto the GLC column. The separation of the FAME was performed on a HP-5MS capillary GLC column (HP, 30 m × 0.32 mm i.d; 0.25 mm film thickness) using He as the carrier gas. MS interface and injector temperature was fixed at 270°C and 260°C respectively. Oven temperature was instituted to 160°C at 2.5 min, 160 to 260°C at 4°C per min and 260°C at 5 min. Data were recorded and analysed on a ChemStation (G1701CA version C.00, USA).

*Statistical analyses*

Statistical analyses were performed using the GLM procedure of the Statistical Analysis Systems Institute software package (1995). The data for growth performance, blood parameters, carcass traits and meat quality were subjected to analysis of least-square means by completely randomised design. The model included the effect of FOMP treatment. The results were given as means and standard deviation.

## Results and discussion

The results of growth performance in finishing pigs are presented in Table 3. ADG (kg/day) was similar in C and T1. It was significantly higher ($P < 0.05$) in C and T1 than in T2 and T3. It was significantly higher ($P < 0.05$) in T2 than in T3. ADFI (kg/day) significantly increased ($P < 0.05$) by the addition of FOMP. FCR also significantly increased ($P < 0.05$) by the addition of FOMP but it was similar between C and T1. Canibe and Jensen (2003) reported that fermented liquid feed contained high level of lactic acid than non-fermented liquid feed. Kim *et al.* (2006a and b) also reported that growth performance of finishing pig was affected by addition of fermented diet. Other studies have also reported that growth performance can be affected by diet ingredients (Radcliffe *et al.*, 1998; Overland *et al.*, 2000; Rosenvold *et al.*, 2001; Canibe and Jensen, 2003). Our results indicate that final weight and ADG were not different until addition of 3% FOMP. However, growth performance was lowered by the addition of 5% FOMP compared with that of the control.

The results of haematological measurements in finishing pigs are presented in Table 4. Leukocyte, erythrocyte, haemoglobin, haematocrit and plastocyte were similar between all treatments. MCV was significantly higher ($P < 0.05$) in C and T1 than in T3. However, T2 was not significantly different with C, T1 and T3 in MCV. MCH was significantly lower ($P < 0.05$) in T3 than other treatments.

**Table 3** *Effect of growth performance in finishing pigs by added levels of fermented oyster mushroom by-product (FOMP) (n = 120)*

| | Treatment[†] | | | |
|---|---|---|---|---|
| | C | T1 | T2 | T3 |
| Live weight (kg) | | | | |
| Initial weight | 71.0 ± 1.2 | 71.3 ± 1.5 | 71.5 ± 1.7 | 71.75 ± 1.3 |
| Final weight | 106.0 ± 0.8[a] | 105.0 ± 1.2[a] | 103.3 ± 1.3[b] | 101.5 ± 1.3[b] |
| Average daily gain (kg/day) | 0.71 ± 0.03[a] | 0.70 ± 0.02[a] | 0.64 ± 0.03[b] | 0.60 ± 0.01[c] |
| Average daily feed intake (kg/day) | 1.78 ± 0.03[d] | 1.90 ± 0.04[c] | 2.04 ± 0.02[b] | 2.11 ± 0.02[a] |
| FCR[‡] (Feed/gain) | 2.52 ± 0.12[c] | 2.70 ± 0.07[c] | 3.17 ± 0.13[b] | 3.52 ± 0.07[a] |

[a,b,c,d] Means with different superscripts in the same row are different at $P < 0.05$.
[†] C, 0% of FOMP; T1, 3% of FOMP, T2, 5% of FOMP, T3, 7% of FOMP.
[‡] FCR, feed conversion ratio.



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**Table 4** *Effect of haematological values in finishing pigs by added levels of fermented oyster mushroom by-product (FOMP) (n = 120)*

| | Treatment[†] | | | |
|---|---|---|---|---|
| | C | T1 | T2 | T3 |
| Leukocyte ($10^3$/mm$^3$) | 21.2 ± 1.9 | 18.7 ± 4.4 | 18.3 ± 5.2 | 20.7 ± 4.7 |
| Erythrocyte ($10^6$/mm$^3$) | 8.94 ± 0.90 | 8.45 ± 0.95 | 7.97 ± 0.15 | 8.99 ± 1.17 |
| Haemoglobin (g/dl) | 16.9 ± 1.9 | 15.9 ± 2.2 | 14.1 ± 0.7 | 14.7 ± 1.8 |
| Haematocrit (%) | 50.2 ± 5.7 | 54.9 ± 18.2 | 41.1 ± 1.7 | 43.6 ± 5.9 |
| Plastocyte ($10^3$/mm$^3$) | 229.7 ± 91.1 | 187.7 ± 24.3 | 259.3 ± 55.2 | 319.0 ± 69.8 |
| MCV[‡] (μm$^3$) | 56.0 ± 2.7$^a$ | 54.3 ± 2.5$^a$ | 51.7 ± 2.3$^{ab}$ | 48.3 ± 1.2$^b$ |
| MCH[‡] (pg) | 19.0 ± 0.8$^a$ | 18.8 ± 0.5$^a$ | 17.7 ± 0.9$^a$ | 16.3 ± 0.2$^b$ |
| MCHC[‡] (g/dl) | 33.8 ± 0.2 | 34.8 ± 0.6 | 34.3 ± 0.4 | 33.73 ± 0.5 |

[a,b] Means with different superscripts in the same row are different at $P < 0.05$.
[†] C, 0% of FOMP; T1, 3% of FOMP, T2, 5% of FOMP, T3, 7% of FOMP.
[‡] MCV, mean corpuscular volume; MCH, means corpuscular haemoglobin; MCHC, mean corpuscular haemoglobin concentration.

MCHC was not significantly different among all treatments. Our results show that addition of FOMP did not affect leukocyte, erythrocyte, haemoglobin, haematocrit and plastocyte.

The results of plasma biochemical composition in finishing pigs are presented in Table 5. Total cholesterol, HDL cholesterol, LDL cholesterol, total protein and BUN were significantly higher ($P < 0.05$) in T3 than other treatments. However, these were not significantly different between C, T1 and T2. Some researchers have reported that cholesterol in serum decreased by additional levels of oyster mushroom in the diet (Bobek *et al*., 1998; Cheung, 1998; Hossain *et al*., 2003). Bobek *et al.* (1991) also reported that whole mushroom retarded the increase in cholesterol in serum. The results in this study indicate that plasma biochemical parameters were not different until addition of more than 5% FOMP in Berkshire during finishing days.

The results of carcass traits and chemical composition in LM by the addition of FOMP are presented in Table 6. In carcass traits, carcass weight (kg) was significantly higher ($P < 0.05$) in C and T1 than in T2 and T3. Dressing (%) was significantly higher ($P < 0.05$) in C than T3. However, T1 and T2 were not significantly different from C and T3. Backfat thickness (μm) was significantly higher ($P < 0.05$) in T3 compared with that in C and T1. However, T2 was not significantly different from C, T1 and T3. In chemical composition, moisture was not significantly different between all treatments. Crude protein was significantly lower ($P < 0.05$) in T3 than other treatments. Crude fat was significantly higher ($P < 0.05$) in T2 and T3 than in C but T1 was not significantly different from other treatments. Crude ash was similar between all treatments. Carcass weight, dressing and backfat thickness were not different when compared with C until the addition of 3% FOMP for Berkshire during finishing days. Some studies have reported that crude fat in meat decreased with an increase in crude protein (Shields *et al*., 1983). Kim *et al.* (2006a) reported that chemical composition of meat was affected by the addition of fermented diet. Our study indicates that addition of up to 5% of FOMP decreased carcass weight and dressing, and increased backfat thickness when compared with C.

The results of meat quality characteristics, meat colour in LM and backfat colour are presented in Table 7. The $pH_{24}$ was significantly higher ($P < 0.05$) in C than other treatments and was significantly higher ($P < 0.05$) in T1 and T3 than in T2. Cooking loss (%) was significantly higher ($P < 0.05$) in T1 than in T2. However, T1 and T2 were not significantly different from C and T3. WHC (%) was significantly higher ($P < 0.05$) in C than in T1 but T2 and T3 was similar to C and T1. In meat colour, CIE L* was similar across all treatments. CIE a* was significantly lowered ($P < 0.05$) by the addition of FOMP. T1 was not significantly different from T2 and T3. CIE b* was

**Table 5** *Effect of plasma biochemical composition in finishing pigs by added levels of fermented oyster mushroom by-product (FOMP) (n = 120)*

| | Treatment[†] | | | |
|---|---|---|---|---|
| | C | T1 | T2 | T3 |
| Total cholesterol (mg/dl) | 113.6 ± 14.0$^b$ | 120.3 ± 5.1$^b$ | 118.3 ± 4.9$^b$ | 142.6 ± 11.6$^a$ |
| HDL cholesterol[‡] (mg/dl) | 65.6 ± 1.5$^b$ | 64.0 ± 3.0$^b$ | 65.0 ± 1.7$^b$ | 85.3 ± 2.4$^a$ |
| LDL cholesterol[‡] (mg/dl) | 35.1 ± 4.3$^b$ | 34.9 ± 1.4$^b$ | 32.1 ± 2.8$^b$ | 41.4 ± 1.9$^a$ |
| Total protein (g/dl) | 6.73 ± 0.47$^b$ | 6.53 ± 0.31$^b$ | 6.87 ± 0.38$^b$ | 7.70 ± 0.52$^a$ |
| BUN[‡] (mg/dl) | 15.7 ± 2.6$^b$ | 14.6 ± 1.3$^b$ | 18.4 ± 1.9$^b$ | 25.0 ± 5.4$^a$ |

[a,b] Means with different superscripts in the same row are different at $P < 0.05$.
[†] C, 0% of FOMP; T1, 3% of FOMP, T2, 5% of FOMP, T3, 7% of FOMP.
[‡] HDL, cholesterol, high-density lipoprotein cholesterol; LDL, cholesterol, low-density lipoprotein cholesterol; BUN, blood urea nitrogen.



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**Table 6** *Effect of carcass traits and chemical composition in longissimus dorsi muscle by added levels of fermented oyster mushroom by-product (FOMP) (n = 120)*

| | Treatment[†] | | | |
|---|---|---|---|---|
| | C | T1 | T2 | T3 |
| Carcass traits | | | | |
| Carcass weight (kg) | 81.5 ± 1.3[a] | 80.3 ± 1.0[a] | 78.0 ± 0.8[b] | 76.0 ± 1.4[b] |
| Dressing (%) | 76.9 ± 1.0[a] | 76.1 ± 1.1[ab] | 75.7 ± 0.2[ab] | 75.3 ± 1.2[b] |
| Backfat thickness (mm) | 26.5 ± 0.6[b] | 26.5 ± 1.3[b] | 27.5 ± 0.6[ab] | 28.3 ± 1.0[a] |
| Chemical composition (%) | | | | |
| Moisture | 73.4 ± 0.6 | 73.7 ± 0.4 | 73.1 ± 0.2 | 73.2 ± 0.6 |
| Crude protein | 23.5 ± 0.2[a] | 23.5 ± 0.3[a] | 23.68 ± 0.4[a] | 22.9 ± 0.3[b] |
| Crude fat | 4.36 ± 0.51[b] | 4.77 ± 0.49[ab] | 5.20 ± 0.68[a] | 5.34 ± 0.82[a] |
| Crude ash | 1.19 ± 0.03 | 1.16 ± 0.06 | 1.14 ± 0.10 | 1.22 ± 0.06 |

[a,b] Means with different superscripts in the same row are different at $P < 0.05$.
[†] C, 0% of FOMP; T1, 3% of FOMP, T2, 5% of FOMP, T3, 7% of FOMP.

significantly higher ($P < 0.05$) in C than other treatments. In backfat colour, CIE L* was significantly lower ($P < 0.05$) in T3 than other treatments. CIE a* was significantly higher ($P < 0.05$) in C than other treatments. CIE b* was significantly lower ($P < 0.05$) by the addition of FOMP and was similar to T2 and T3. Rosenvold *et al.* (2002) reported that pH and meat colour were affected by diet ingredients. Kim *et al.* (2006a) reported that meat quality characteristics, meat and backfat colour were affected by the addition of fermented diet. Our research indicates that meat quality characteristics, meat and backfat colour in meat were changed by the addition of FOMP in finishing Berkshire.

The fatty acids in LM are presented in Table 8. Myristic acid was significantly higher ($P < 0.05$) in T3 than other treatments. Palmitic acid was significantly higher ($P < 0.05$) in C than other treatments. Palmitoleic acid was significantly higher ($P < 0.05$) in T3 than other treatments. Stearic acid was significantly higher ($P < 0.05$) in C than other treatments. Oleic acid was significantly higher ($P < 0.05$) in T3 than other treatments and was lower ($P < 0.05$) in T2 than other treatments. Linoleic and arachidonic acids were significantly higher ($P < 0.05$) in T2 than other treatments but were significantly lower ($P < 0.05$) in T3 than other treatments. Saturated fatty acid (SFA) was significantly higher but unsaturated fatty acid (USFA) was significantly lower ($P < 0.05$) in C than other treatments. SFA/USFA was significantly higher ($P < 0.05$) in C than other treatments. Some researchers have reported that fatty acid composition of meat could be improved by the diet (French *et al.*, 2000; Hsia and Lu, 2004; Nuernberg *et al.*, 2005). Suzuki *et al.* (2003) reported that in general, SFAs of meat are palmitic acid and stearic acid in Berkshire, and USFAs are oleic and linoleic acid. The same results were found in our study. Our results indicated that fatty acids were affected by the addition of FOMP in Berkshire during the finishing days.

**Table 7** *Effect of meat quality characteristics, and meat and backfat colour in longissimus dorsi muscle by added levels of fermented oyster mushroom by-product (FOMP) (n = 120)*

| | Treatment[†] | | | |
|---|---|---|---|---|
| | C | T1 | T2 | T3 |
| Meat quality characteristics | | | | |
| $pH_{24}$ | 5.82 ± 0.13[a] | 5.68 ± 0.03[b] | 5.55 ± 0.01[c] | 5.66 ± 0.10[b] |
| Cooking loss (%) | 15.1 ± 2.3[ab] | 16.9 ± 1.6[a] | 13.6 ± 2.5[b] | 15.2 ± 1.1[ab] |
| WHC (%)[‡] | 82.9 ± 6.1[a] | 74.7 ± 3.3[b] | 77.3 ± 3.4[ab] | 81.0 ± 6.8[ab] |
| Meat colour[§] | | | | |
| CIE L* | 43.3 ± 2.4 | 41.6 ± 2.1 | 42.1 ± 0.8 | 43.5 ± 2.0 |
| CIE a* | 6.86 ± 0.28[a] | 5.54 ± 0.66[bc] | 6.07 ± 0.64[b] | 5.29 ± 0.55[c] |
| CIE b* | 4.11 ± 0.50[a] | 2.89 ± 0.43[b] | 2.75 ± 0.38[b] | 2.73 ± 0.29[b] |
| Backfat colour[§] | | | | |
| CIE L* | 73.1 ± 0.8[a] | 72.6 ± 0.7[a] | 73.3 ± 1.1[a] | 70.5 ± 0.5[b] |
| CIE a* | 3.13 ± 0.55[a] | 2.16 ± 0.12[b] | 1.69 ± 0.48[b] | 1.86 ± 0.49[b] |
| CIE b* | 4.31 ± 0.48[a] | 3.52 ± 0.10[b] | 3.00 ± 0.21[c] | 3.07 ± 0.41[c] |

[a,b,c] Means with different superscripts in the same row are different at $P < 0.05$.
[†] C, 0% of FOMP; T1, 3% of FOMP, T2, 5% of FOMP, T3, 7% of FOMP.
[‡] WHC, water-holding capacity.
[§] CIE L* = Black (0) to white (100) scale, CIE a* = red (+) to green (−) colour scale, CIE b* = yellow (+) to blue (−) colour scale.



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**Table 8** *Effect of fatty acids in longissimus dorsi muscle by added levels of fermented oyster mushroom by-product (FOMP) (n = 120)*

| | Treatment[†] | | | |
|---|---|---|---|---|
| | C | T1 | T2 | T3 |
| Myristic acid | 1.07 ± 0.09[ab] | 0.91 ± 0.06[b] | 0.92 ± 0.17[b] | 1.23 ± 0.41[a] |
| Palmitic acid | 22.1 ± 0.9[a] | 19.9 ± 0.2[b] | 20.3 ± 0.5[b] | 20.2 ± 0.3[b] |
| Palmitoleic acid | 2.62 ± 0.39[b] | 3.00 ± 0.22[b] | 2.94 ± 0.51[b] | 4.58 ± 0.56[a] |
| Stearic acid | 12.1 ± 0.8[a] | 8.74 ± 0.61[b] | 8.83 ± 0.39[b] | 8.06 ± 0.64[b] |
| Oleic acid | 43.7 ± 0.7[c] | 45.3 ± 0.4[b] | 40.6 ± 0.8[d] | 50.8 ± 0.9[a] |
| Linoleic acid | 14.5 ± 0.8[c] | 17.1 ± 0.4[b] | 18.8 ± 0.8[a] | 12.3 ± 0.6[d] |
| Arachidonic acid | 3.97 ± 0.58[c] | 5.16 ± 0.76[b] | 7.62 ± 0.75[a] | 2.84 ± 0.82[d] |
| SFA[‡] | 35.2 ± 1.2[a] | 29.5 ± 0.6[b] | 30.1 ± 0.8[b] | 29.4 ± 0.6[b] |
| USFA[‡] | 64.8 ± 1.2[b] | 70.5 ± 0.9[a] | 70.0 ± 0.6[a] | 70.6 ± 0.6[a] |
| SFA/USFA | 0.54 ± 0.03[a] | 0.42 ± 0.01[b] | 0.43 ± 0.01[b] | 0.42 ± 0.01[b] |

[a,b,c,d] Means with different superscripts in the same row are different at $P < 0.05$.
[†] C, 0% of FOMP; T1, 3% of FOMP, T2, 5% of FOMP, T3, 7% of FOMP.
[‡] SFA, saturated fatty acids; USFA, unsaturated fatty acids.

In conclusion, growth performance, blood parameters, carcass traits and meat quality of Berkshire were changed by the addition of FOMP during the finishing days. Final weight and ADG were not found to be different between 3% FOMP and control diet. Plasma chemical composition was not different until the addition of 5% FOMP. Carcass traits, meat quality characteristics and fatty acids in LM of Berkshire were changed by addition of FOMP in finishing diet. Addition of up to 3% FOMP produced more significant results than 5% FOMP.

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