EFFECT OF DIETARY *Agaricus bisporus* AND *Auricularia auricula* CRUDE EXTRACT SUPPLEMENTATION ON CARCASS QUALITY OF BROILER

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Submitted 15 June 2020; Accepted 27 July 2020

ABSTRACT

This research was conducted to examine *Agaricus bisporus* and *Auricularia auricula* crude extract using different solvents (water, ethanol, and methanol) on infrared spectroscopy absorbance during extraction and the impact on broiler carcass. *Agaricus bisporus* and *Auricularia auricula* crude extracts were scanned using fourier transform infrared (FT-IR) spectroscopy. Each mushroom crude extract was chosen and applied into broiler diets as feed additive at 0%, 0.4%, 0.8%, 1.2%, and compared zinc bacitracin inclusion. Variable measured were final live weight, carcass yield, breast meat yield, and abdominal fat yield of broiler. Two hundred and forty day-old chicks were randomly allocated into eight dietary treatments, each treatment was replicated three times with ten chicks for each pen. Diets and water were offered *ad libitum*. Methanolic extract showed monosaccharide absorption peak in fingerprint region at wavelength 890 cm^{-1} , 930 cm^{-1} , 1050 cm^{-1} , 1150 cm^{-1} which indicates alpha and beta linkage than the others solvent. Even so, dietary inclusion of methanolic extracts of *Agaricus bisporus* and *Auricularia auricula* did not show any effect on final live weight and the yield of carcass, breast meat and abdominal fat of broiler. In conclusion, methanolic extraction is effective to extract monosaccharides with α - and β - linkages from *Agaricus bisporus* and *Auricularia auricula*, while the dietary inclusion of methanolic extracts of both edible mushroom and zinc bacitracin has no effect on carcass quality of broiler in broiler diets did not show differences between treatments as well as zinc bacitracin group.

Keyword: Antibiotics; broiler carcass; mushroom extract; prebiotics; probiotics

INTRODUCTION

The use of antibiotic growth promoter (AGP) in poultry and cattle industry in Indonesia has been banned since early 2018. Common AGP used in poultry industry was zinc bacitracin which is used to optimize broiler growth. Zinc bacitracin usage in long term in poultry diets may induce the deposition of the antibiotic residue to poultry products such as meat and egg. Antibiotics residue in poultry products may impact on human immune system against antimicrobial-resistance bacteria. There has been much research evaluating some alternative ways to replace AGP in poultry production. In this study, glucans from the mushroom play a role as prebiotic.

Agaricus bisporus and *Auricularia auricula* are two kinds of edible mushroom which contain many therapeutic polysaccharides. Most polysaccharide in *Agaricus bisporus* and *Auricularia auricula* are in the form of glucan. β -glucan from *Agaricus bisporus* and *Auricularia auricula* activate macrophages cell and may improve host immunity (Minato and Abe, 2013). Conventional extraction is usually performed in long time period of time (more than 2 h) at reflux temperature 90 °C. While microwave assisted extraction may increase yield extract at short time and reduce solvent usage (Proestos and Komaitis, 2008). Water usage as solvent will absorb more microwave energy, therefore solvent polarity is very important to be considered. Common polar solvents showed better result in polysaccharides extraction by using microwave assisted extraction than non-polar solvents (Wang and Weller, 2006).

Agaricus bisporus and *Auricularia auricula* are two kinds of mushroom which cultivate in subtropical climate such as

Indonesia. Liu *et. al.* (2013) reported that ethanolic extract of *Agaricus bisporus* showed better antioxidant activity against various radical scavengers, and *Agaricus bisporus* ethanolic extract could be natural antioxidant and therapeutic agents. Infrared spectra of *Auricularia auricula* extracted using microwave assisted extraction showed stretching vibration of -OH and C-H at about 3600-3200 cm^{-1} and 300-2800 cm^{-1} , then the absorption at 903 cm^{-1} indicates β -glycosidic linkages as β -glucan and the peak at 1145, 1075, and 1042 cm^{-1} showed sugar form as pyranose. Microwave assisted extraction could influence the molecular weight of the polysaccharide and the molecular weight changes could affect the bioactivity of the polysaccharide (Zeng *et. al.*, 2012; Feng *et. al.*, 2010). The combination between β -glucan and antibiotic addition into weanling pigs diets could increase dry matter, gross energy, crude protein, and crude fat digestibility (Hahn *et. al.*, 2006).

Agaricus bisporus is known to play a role as immunomodulatory agent and growth performance of broiler and turkey (Guimarães *et al.*, 2014; Giannenas *et al.*, 2011). *Agaricus bisporus* additional in laying hen diets showed 2% residual stem from white button mushroom improve laying hens performance and increase nutrient utilization (Yang *et. al.*, 2020). Another study based on Shamsi *et. al.* (2015) reported that the inclusion of 0.2% powdered *Agaricus bisporus* into broiler diets significantly reduced daily feed intake and feed conversion ratio. The lack study investigated influence of *Agaricus bisporus* and *Auricularia auricula* crude extract in broiler diets to replace AGP in broiler diets is required. The objective of this study was to investigate *Agaricus bisporus* and

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How to cite:

Natsir, M. H., Sjojfan, O., Ardyansah, R. H. (2020). Effect of Dietary *Agaricus bisporus* and *Auricularia auricula* Crude Extract Supplementation on Carcass Quality of Broiler. Jurnal Ilmu dan Teknologi Hasil Ternak, 15 (3), 183-193

Auricularia auricula crude extract structure changes during extraction process using microwave assisted extraction (MAE) with different solvents by infrared spectroscopy and the impact of the inclusion of the mushroom extracts in diets on the carcass quality of broiler.

MATERIALS AND METHODS

Mushroom preparation and extraction

Agaricus bisporus and *Auricularia auricula* were purchased from local mushroom farmer in Singosari sub district, Malang District, East Java, Indonesia. The fresh mushroom were sliced to reduce the size, then soaked using three different solvents (water, ethanol 96%, and methanol 70%) for 24 h. Extraction was performed using a modified microwave (50 Hz, 399 watt) (Purwanto *et. al.*, 2010) with additional equipment vacuum pump. MAE of the edible mushroom was done at 50°C for

15 min. The crude extract was then filtered using cheese cloth and its extraction schematics is shown in Fig. 1. The filtrate was evaporated using MAE for second time for 15 min to get crude extract from *A. bisporus* and *A. auricula*. Crude mushroom extract was stored into freezer at -20°C for in-vivo trial. Both mushroom crude extracts were centrifuged under 3500 rpm at about 15 min, then separate between supernatant and solid fraction. Solid fraction after centrifuged were dried using microwave under 50°C for 10 min. Then 3 mg of powdered *Agaricus bisporus* and *Auricularia auricula* crude extract mix with 97 mg of KBr (Merck KGaA, 54271 Darmstadt, Germany) then pressed by using KBr press holder. Finally the spectra was scanned in wavelength range 500-4000 cm^{-1} with FT-IR spectrophotometer. FT-IR analysis was performed at central laboratory of State University of Malang (**Experiment 1**).

Figure 1. Microwave assisted extraction schematics (1: thermo control; 2: solvent and symlisia; 3: removeable flask; 4: cooling water outlet; 5: cooling water inlet; 6: air controller; 7: vacuum pump)

Animals and experimental design

Two hundred and forty day-old chicks (unsex) were randomly allocated into 8 experimental groups with average body weight of $37,6 \pm 2,90$ g/chick. Three replication were done for each treatment with ten chicks in each pen. The dimensions of the pen were $1 \times 1,2 \times 0,8 \text{ m}^3$ and equipped by hanging feeder and drinker. The feed and water given *ad libitum*. During ten days, all chicks got brooding phase with controlled room temperature at 26-35°C and humidity 65%-75%. The experiment was

done in 35 d. Basal diet BR1 was given at the first 21 d (starter period), and BR2 was given later until 35 d (finisher period), basal diets purchased from PT. Japfa Comfeed, Indonesia. Chemical composition of the basal diet is shown in Table 1.

The 8 experimental group were control (P0), basal diets containing zinc bacitracin as positive control (P1), basal diets containing *Agaricus bisporus* crude extract of 0.4% (P2), 0.8% (P3), 1.2% (P4), and basal diets containing *Auricularia auricula* crude extract of 0.4% (T5),

0.8% (T6), 1.2% (T7). Each experimental feed were prepared daily and given twice a day in the morning and afternoon, then

mushroom crude extract was sprayed onto the basal diets (**Experiment 2**).

Table 1. Chemical composition of basal diets (BR1 and BR2)^a.

Chemical composition	BR1 ^c	BR2 ^d
Dry matter (%)	86.58	86.49
Crude Protein (%) ^b	23.09	20.93
Crude fat (%) ^b	6.07	5.25
Crude fiber (%) ^b	3.55	5.25
Ash (%) ^b	6.14	4.92

^a Based on Animal Feed Laboratory, Faculty of Animal Science, Universitas Brawijaya

^b Based on 100 % dry matter

^c Ingredients: Corn, SBM, MBM, CGM, Palm olein, Lysine, Methionine sodium bicarbonate, Vitamin, Calcium, Phosphorus, Mineral.

^d Ingredients: Corn, SBM, MBM, CGM, CPO, Essential amino acid, Essential mineral, Premix, Vitamin.

Broiler carcass measurements

The spectra of *Agaricus bisporus* and *Auricularia auricula* crude extract using FT-IR spectroscopy to investigate the absorption banding from polysaccharides of both edible mushroom crude extracts. Meanwhile, in experiment 2 on day 35, the broilers were weighed and sampling was performed by marking a broiler with average weight for every pen. The samples were then slaughtered. The yield of the carcass, breast meat and abdominal fat was determined according to the following formula:

$$\text{Carcass (\%)} = \frac{\text{Carcass weight (g)}}{\text{Live weight (g)}} \times 100$$

$$\begin{aligned} \text{Breast meat (\%)} &= \frac{\text{Filleted breast meat (g)}}{\text{Carcass weight (g)}} \\ &\times 100 \end{aligned}$$

$$\begin{aligned} \text{abdominal fat (\%)} &= \frac{\text{Abdominal fat (g)}}{\text{Live weight (g)}} \times 100 \end{aligned}$$

Statistical analysis

The spectrum data from FT-IR spectroscopy analysis (experiment 1) were analyzed descriptively. Meanwhile, the data from experiment 2 were analyzed using a one-way ANOVA with a completely

randomized design (CRD). The orthogonal contrast tests were performed later for all variables using Minitab® 18.1 (Minitab Inc, USA).

RESULTS AND DISCUSSION

Infrared spectrum of *Agaricus bisporus* crude extract are shown in Fig. 2 and Table 2. *Agaricus bisporus* crude extract showed peak at 930 cm⁻¹ stretching vibration which indicates the presence of β-1,4-glucan. Then peak at 850 cm⁻¹ in KAA, KAE, and KAM which indicates the existence of alpha bound linkages in fingerprint region. KAE showed strongest alpha banding of monosaccharides that is alpha peak absorption at 893,0 cm⁻¹ while KAA and KAM alpha peak absorption at 848,7 and 852,5 cm⁻¹. It indicates that solvent usage may dilute α-glucan from *Agaricus bisporus*. El-Batal *et. al.* (2008) stated that absorption on fingerprint region at 890 cm⁻¹ indicates 1,3-β-glucan banding, while absorption at 930 cm⁻¹ indicates β(1,4) polysaccharide.

The band attributed to C-O stretching vibration appeared at wavelength 1045 cm⁻¹, where is KAE did not show any absorption in these wavelength region. The group of C-H banding appeared as absorption peaked at 1085,9 cm⁻¹ in KAC and 1099,4 cm⁻¹ in

KAM, which KAA and KAE did not show C-H group in these wavelength. Stretching vibration at wavelength 1150 cm^{-1} showed C-O-C banding group, stretching vibration of C-O-C in KAC appeared at wavelength $1147,7\text{ cm}^{-1}$, KAA at wavelength $1122,6\text{ cm}^{-1}$, KAE at $1149,6\text{ cm}^{-1}$, while KAM showed stronger C-O-C stretching

vibration banding group at wavelength $1166,9\text{ cm}^{-1}$. Wavelength range at $1175\text{--}1140\text{ cm}^{-1}$ indicate that C-O banding group appeared at 1147 cm^{-1} with medium intensity as α -D-glucose, and appear absorption at 1153 cm^{-1} C-O banding group as β -D-glucose that is monosaccharide molecule (Nikonenko *et. al.*, 2000).

Table 2. FT-IR spectra of *A. bisporus* crude extract

<i>A. bisporus</i> (KAC)			<i>A. bisporus</i> crude water extract (KAA)		
Wavelength (cm^{-1})	Group	Type of Vibration	Wavelength (cm^{-1})	Group	Type of Vibration
931.6	beta 1.4 glucan		848,7	alpha chain	
1026.1	C-O	stretching	929.7	beta 1.4 glucan	
1085.9	C-H	bending	1043.5	C-O	stretching
1147.7	C-O-C	stretching	1122.6	C-O-C	stretching
2873.9	C-H	stretching	2875.9	C-H	stretching
			3263.6	O-H	stretching
<i>A. bisporus</i> crude ethanol extract (KAE)			<i>A. bisporus</i> crude methanol extract (KAM)		
Wavelength (cm^{-1})	Group	Type of Vibration	Wavelength (cm^{-1})	Group	Type of Vibration
893.0	alpha chain		852.5	alpha chain	
935.5	beta 1.4 glucan		937.4	beta 1.4 glucan	
			1031.9	C-O	stretching
			1099.4	C-H	tekukan
1149.6	C-O-C	stretching	1166.9	C-O-C	stretching
1429.3	C-H ₄	bending	1425.4	C-H ₄	bending
1685.8	C=O	stretching	1691.6	C=O	stretching
2873.9	C-H	stretching	2953.0	C-H	stretching
3286.7	O-H	stretching	3421.7	O-H	stretching

There are peak absorption of bending vibration C-H alkana banding group in KAE ($1429,3\text{ cm}^{-1}$) and KAM ($1425,4\text{ cm}^{-1}$), while KAC and KAA did not shown bending vibration of C-H alkana banding group. KAE and KAM absorption peak appeared at wavelength $1685,8\text{ cm}^{-1}$ and $1691,6\text{ cm}^{-1}$ of C=O stretching vibration banding group from monosaccharide. Stretching vibration of C-H banding group appeared at wavelength $2873,9\text{ cm}^{-1}$ (KAC), $2875,9\text{ cm}^{-1}$ (KAA), $2873,9\text{ cm}^{-1}$ (KAE), dan $2953,0\text{ cm}^{-1}$ (KAM), which is KAM showed stronger stretching vibration of C-H

banding group. Hydrogen bond of -OH stretching vibration group appeared at wavelength $3263,6\text{ cm}^{-1}$ on KAA, $3286,7\text{ cm}^{-1}$ on KAE, and $3421,7\text{ cm}^{-1}$ on KAM which is KAC did not show stretching vibration of -OH banding group. There was an absorption enlargement at $3000\text{--}3500\text{ cm}^{-1}$ for *A. bisporus* extract. Kozarski *et. al.* (2011) reported that polysaccharide from hot-water extraction of *A. bisporus* appear peak absorption at $3416,5\text{ cm}^{-1}$ indicate -OH group, then -CO group appear peak absorption at 1023 cm^{-1} , and C-O-C banding group appeared at 1155 cm^{-1} , and absorption

at 850 cm^{-1} indicating α - banding group. There are different result between *Agaricus* species differences, Whereas *Agaricus bisporus* contain glucose compound more

than 85% while *agaricus brasiliensis* contain glucose 58% and complex glycan. Which is α -glucan in *Agaricus brasiliensis* higher than β -glucan (Kozarski *et. al.*, 2011).

Figure 2. FT-IR spectroscopy of *Agaricus bisporus* crude extract (a: control group; b: water solvent; c: ethanol solvent; d: methanol solvent)

Table 3. FT-IR spectra of *A. auricula* crude extract

<i>A. auricula</i> (KUC)			<i>A. auricula</i> crude water extract (KUA)		
Wavelength (cm ⁻¹)	Group	Type of Vibration	Wavelength (cm ⁻¹)	Group	Type of Vibration
895.0	1.3 beta glucan				
1049.3	C-O	stretching	1045.4	C-O	stretching
1082.1	C-H	bending			
1157.3	C-O-C	stretching			
1253.7	C-O-C	stretching	1246.0	C-O-C	stretching
1317.4	C-H	bending			
2895.2	C-H	stretching	2852.7	C-H	stretching
3226.9	O-H	stretching	3321.4	O-H	stretching
<i>A. auricula</i> crude ethanol extract (KUE)			<i>A. auricula</i> crude methanol extract (KUM)		
Wavelength (cm ⁻¹)	Group	Type of Vibration	Wavelength (cm ⁻¹)	Group	Type of Vibration
935.5	beta 1.4 glucan		929.7	beta 1.4 glucan	
1041.6	C-O	stretching	1041.6	C-O	stretching
			1076.3	C-H	bending
1145.7	C-O-C	stretching	1147.7	C-O-C	stretching
1242.2	C-O-C	stretching	1242.2	C-O-C	stretching
1317.4	C-H	bending	1317.4	C-H	bending
			1745.6	C=O	stretching
2850.8	C-H	stretching	2852.7	C-H	stretching

Infrared spectrum of *Auricularia auricula* crude extract are shown in Fig. 3 and Table 3. *Auricularia auricula* crude extract did not show peak at 890 cm^{-1} indicating the absence of β -glycosidic linkages. Meanwhile, KUC shown peak absorption at wavelength $895,0\text{ cm}^{-1}$ from 1,3- β -glucan. However, the extract of *A.*

auricula did not show absorption at these wavelengths as 1,3- β -glucan could not be diluted. KUE and KUM showed peak absorption at $935,48\text{ cm}^{-1}$ and $929,69\text{ cm}^{-1}$ which indicates 1,4- β -glucan. 1,4- β -glucan in KUM had lowering peak absorption intensity, while KUC and KUA did not show peak absorption at these wavelength.

Figure 3. FT-IR spectrum of *Auricularia auricula* crude extract (**a**: control group; **b**: water solvent; **c**: ethanol solvent; **d**: methanol solvent)

Table 4. The effect of *Agaricus bisporus* and *Auricularia auricula* crude extract on broiler performance at 35 days of age^a.

Treatments	Final live weight (g/chick)	Carcass yield (%)	Breast meat yield ^b (%)	Abdominal fat yield ^c (%)
P0	2171±45.7	73.5±1.8	30.5±3.2	1.41±0.38
P1	2163±3.0	73.0±2.1	31.0±3.6	1.65±0.14
P2	2154±46.8	72.9±0.6	29.2±2.2	1.20±0.13
P3	2217±39.5	70.6±4.1	29.1±3.0	1.49±0.26
P4	2107±26.8	71.9±2.4	29.1±1.7	1.19±0.09
P5	2163±54.8	73.5±0.3	29.9±0.7	1.51±0.83
P6	2182±131.9	72.4±3.0	29.4±1.6	1.72±0.16
P7	2138±90.7	73.5±3.6	30.5±1.9	1.49±0.58

^a Results are given as means ± standard deviation

^b Data are shown based on 100% carcass weight

^c Data are shown based on 100% live weight

Table 5. Significance levels of orthogonal contrast tests on broiler's final weight and carcass quality^a.

Treatments	Live weight (g/chick)	Carcass (%)	Breast meat (%)	Abdominal fat (%)
P0vsP1-P7	0.676	0.846	0.954	0.704
P1vsP2-P7	0.797	0.567	0.608	0.837
P2-P4vsP5-P7	0.939	0.733	0.346	0.395
P2vsP3-P4	0.952	0.278	0.489	0.157
P3vsP4	0.869	0.359	0.947	0.638
P5vsP6-P7	0.055	0.553	0.969	0.377
P6vsP7	0.944	0.751	0.989	0.732

^a *P-value* on orthogonal contrast tests

Then peak absorption stretching vibration of C-O carbonyl group appeared at wavelength 1049,3 cm⁻¹ (KUC), 1045,0 cm⁻¹ (KUA), 1041,6 cm⁻¹ (KUE), and 1041,6 cm⁻¹ (KUM) (commonly appeared at wavelength 1050-1300 cm⁻¹). The band attributed to bending vibration of C-H group appeared at wavelength 1082,1 and 1076,3 cm⁻¹. The band attributed to C-O-C stretching vibration appeared at wavelength 1157,4 cm⁻¹ in KUC, KUE and KUM showed reducing absorption intensity at wavelength 1145,7 dan 1147,7 cm⁻¹. Meanwhile KAA did not show absorption peak at 1150 cm⁻¹. Then appeared stretching vibration of C-O-C banding group at wavelength 1147,7 cm⁻¹ in KAC, 1122,6 cm⁻¹ in KAA, 1149,6 cm⁻¹ in KAE, and stronger C-O-C banding group of KAM appeared at wavelength 1166,9 cm⁻¹. The band attributed to bending vibration of C-H alkana banding group appeared at wavelength 1429,3 cm⁻¹ in KAE and 1425,4 cm⁻¹ in KAM, while KAC and KAA did not show bending vibration of C-H alkana banding group at these region. KAE and KAM showed peak absorption at wavelength 1685,8 dan 1691,6 cm⁻¹ which is indicate of C=O banding group. Then peak absorption appeared at wavelength 2873,9 cm⁻¹ (KAC), 2875,9 cm⁻¹ (KAA), 2873,9 cm⁻¹ (KAE), and 2953,0 cm⁻¹ (KAM) which indicates stretching vibration of C-H banding group. Peak absorption at wavelength 3263,6 cm⁻¹ pada KAA, 3286,7 cm⁻¹ pada KAE, and 3421,7 cm⁻¹ in KAM showed stretching vibration hydrogen

bond of -OH banding group. Which in KAC did not found stretching vibration of -OH banding group. Zeng *et. al.* (2012) reported that microwave assisted extraction technology on *Auricularia auricula* showed absorption peak at 3435 cm⁻¹ and 2927 cm⁻¹ that is indicate -OH stretching vibration and C-H bending vibration. Then absorption peak appeared at 903 cm⁻¹ represents β-glycosidic bond linkage. Based on *Agaricus bisporus* crude extract IR spectrum, methanolic extract showed absorption peak at 890 cm⁻¹ representing 1,3-β-glycosidic linkages, 930 cm⁻¹ representing 1,4-β-glycosidic linkages, and 1150 cm⁻¹ representing C-O-C stretching vibration, and the absorption peaks appeared in these regions indicate sugar conformation (Nikonenko *et. al.*, 2000). *Auricularia auricula* water extract did not show absorption peak at 1150 cm⁻¹ and 930 cm⁻¹, while methanolic extract showed absorption peak at 1150 cm⁻¹ and 930 cm⁻¹.

Based on analysis of variance (ANOVA) there are no significant differences between treatments on carcass quality of broiler. The non significant differences caused of *Agaricus bisporus* and *Auricularia auricula* crude extract addition of 1.2% in broiler diets did not changes the nutrient utilization. In previous study Kavyani *et. al.* (2012) reported that 1% dry *Agaricus bisporus* inclusion in broiler diets significant increase broiler body weight at 21 days of rearing compared with antibiotics group (flavophospholipol). Gut health could improve broiler performance, which

balancing intestinal microflora could improve efficiency of utilization and digestibility of feed. Based on IR spectroscopy analysis, both mushroom crude extract contained β -glucan which play antioxidant and therapeutic agents in poultry diets. β -glucan contained in *Agaricus bisporus* and *Auricularia auricula* may improve broiler live weight. Dietary β -glucan could reduce digesta viscosity in small intestine, so nutrient absorption will increase with reduce organism fermentation time by endogenous enzyme (Huyghebaert *et. al.*, 2011). Major polysaccharides in *Agaricus bisporus* and *Auricularia auricula* are β -D-glucan, which induces immune response to stimulate macrophage proliferation.

Carcass yield in Table 2 showed that *Agaricus bisporus* and *Auricularia auricula* crude extract addition in average 70.6 – 73.5%, which is broiler carcass yield at about 70 – 75%. In study of 3% yeast cell wall inclusion into broiler diets did not show significant differences compared with oxytetracycline group (Ahmed *et al.*, 2015). Kavyani *et al.* (2012) also reported that 3% *Agaricus bisporus* inclusion in broiler diet showed 73.3% carcass yield with no significant differences between treatments. Another study showed 6% inclusion of white button mushroom simultaneous increase broiler carcass yield (Mazaheri *et al.*, 2014). Breast meat yield in average of 29.1 – 31.0%, there were no significant differences among the treatment, which indicates *Agaricus bisporus* and *Auricularia auricula* crude extract did not affect on broiler breast meat conformation. Meanwhile the lowest abdominal fat percentage showed in *Agaricus bisporus* crude extract 1.2% inclusion with 1.19% of body weight. In addition of edible mushroom crude extract contained β -glucan could stimulate macrophages and dendritic cell which needed more energy transferred into peyer's patches to improve host immunity by increasing CD4 and TCR 1 cells (Yalcin *et. al.*, 2014; Chae *et. al.*, 2006), then balancing energy storages in whole body as

fat. Carcass dressing in this study ranged from 70-73%, whereas similar study by Ahmed *et. al.* (2015) reported carcass dressing percentage in the range of 70-73% without showed significant differences between treatments using *Saccharomyces cerevisiae* inclusion. *Saccharomyces cerevisiae* cell wall is rich in β -1,3-glucan which is important for modulating immune response and nutrient utilization in the small intestine (Nie *et. al.*, 2018).

CONCLUSION

In conclusion, absorption characteristics of the glycosidic bands in α - or β - type of monosaccharides of *A. bisporus* and *A. auricula* crude methanolic extracts were identified using FT-IR spectroscopy. Meanwhile, both edible mushroom crude extracts did not change the carcass quality of broiler.

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