Research Article

Effect of Fermented Rice Bran and Maize by *Saccharomycess cerevisiae* on Carcass Characteristis and Amino Acid Contents of Chickens

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Abstract | It has been shown that fermented rice bran and maize by *Saccharomyces cerevisiae* increases in dry matter, protein digestibility and the villi height in the chicken duodenum. However, whether effects of feed fermentation on carcass characteristics, meat quality and amino acid contents remain unknown. This study was conducted to examine the effects of maize and rice bran fermented with *Saccharomyces cerevisiae* on carcass characteristics, meat quality and amino acid composition of (Ri x Luong Phuong) chicken. The study was carried out using two hundred forty crossbred chickens begging at 28 days of age. Chickens were arranged randomly into two groups (control and fermented) with four replications. The results shown that the fermented feed did not affect on carcass yield or quality of meat parameters (p>0.05). However, most amino acids of breast meat were found at a higher content in the fermented group than in the control group (p<0.05). Especially, the concentration of glutamate, phenylalanine, tyrosine, aspartate, threonine and serine were much higher in the fermented group compared to the control group (p<0.05). Based on aboved results mention that fermentation of maize and rice bran by *Saccharomyces cerevisiae* increased the aroma and taste of chicken meat.

Keywords | Aroma, Chicken, Savoury, Meat quality, *Saccharomyces cerevisiae,* Umami taste

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INTRODUCTION

The production of poultry meat accounts 36% of the total meat in the global, and meat of chicken is 89% of the production of poultry (Gálvez *et al*., 2020; FAO, 2020). Previous studies shown that chicken production is short cycle, the meat is high quality and cheap protein source (Biesek *et al*., 2020; Marangoni, *et al*., 2015). Therefore, the consumptions of chicken meat are increasing in the world. In addition, meat quality is influenced by several factors such as body weight, age, growth performance and feed (Gálik *et al*., 2023). To improve growth performance, utilization of feed and condition of the health, the antibiotics have been supplemented in poultry production (Gollnisch, 2001). However, using antibiotic induce inbalance of dynamics of microbial system in the poultry intestine (Sorum and Sunde, 2001), and antibiotic residues in meat (Imik *et al*., 2006). Thus, many studies in the last decade have been conducted to found some replacements to improve the health and the performance of the poultry. Probiotics is one of the greatest alternatives.

Probiotics are the live micro-organisms. It have been shown that using porbiotics in the poultry diet improved growth performance, feed utilizations, health condition and meat quality (Popova, 2017; Zhang *et al*., 2021; Mohammed *et al*., 2021; Malematja *et al*., 2022). Besides, the feed fermented with probiotics plays an important role in the improvement of feed nutrition (Hasaan *et al*., 2015). Fermentation yields the bioactive peptides resulted from protein cleavage and therefore it increases the biological value of the feedstuff (Steinkaus, 2002). Futhermore, the production of fermented feed are high quality of peptides and amino acids source (Rajapakse *et al*., 2005), increase nutritional values and feed utilization in poultry, reduce crude fiber (Susi, 2012), increase fat and crude protein digestibility (Sukaryana *et al*., 2011), and improve the balance of amino acid (Ari *et al*., 2012).

It is well known that *Saccharomyces cerevisiae* (SC) is one of the type of probiotics. Its have been shown that supplement of SC to the chicken diets improves growth performance, feeds digestibility, feed convertion ratio and meat quality (Lutful-Kabir, 2009; Haldar *et al*., 2011; Cheng *et al*., 2014; Popova, 2017). In addition, fermentation of feeds with SC increased antioxidant properties and mineral availability (Dordevic *et al*., 2010), reduced fat deposition in animal (Santoso *et al*., 2000), improves protein, phosphorus, Methionine and Lysine content (Arzinnahar *et al*., 2021), increased digestibility of dry matter, protein and improved the height of villus in duodenum (Hang *et al*., 2020). However, effects of feed fermetation on carcass characteristics, meat quality and amino acid contents remain unknown. The present study was conducted to examinate the effects of fermented rice bran and maize with SC on carcass characteristics, meat quality and contents of amino acids of crossbred Ri chicken.

MATERIALS AND METHODS

The current study was approved by the protocal of Ethics Committee, Faculty of Agriculture and Technology, University of South Bohemia in České Budějovice (code: 22036/2019-MZE-18134).

Feed preparation

Saccharomyces cerevisiae (SC) was obtained from ICFOOD Company (Ho Chi Minh city, Vietnam). Fermented feeds were prepared as follows: Maize and rice bran from the basal diet (Table 1) were mixed with SC powder at 0.5g/kg of feed (a concentration of 10^7cf/g) and 40% water and kept for aerobic fermentation at 27 - 30 °C (room temperature) in 5 hours, following by put into polythene bag in an anaertobic conditions at room temperature for 3 days. Then, the fermented matter was mixed with the other ingredients of the diet (Table 1). Chemical composition of the basal diet (control) is presented in the Table 1.

Table 1: Ingredients and chemical composition of the basal diet.

Ingredients (%)	Age of chickens (weeks)	
	5 – 7	8 – 13
Yellow maize	59.5	65
Rice bran	15	15
Concentration	25	19.5
Premix	0.5	0.5
Chemical composition		
Crude protein (%)*	19.9	17.9
True protein (%)*	16.6	14.5
Lipids (%)*	5.2	5.1
Crude fiber (%)*	2.7	2.8
Total ash (%)*	6.7	5.7
Metabolic energy (ME, kcal/kg)**	3142.4	3154.5

*Analysed composition at the laboratory of Faculty of Animal Sciences and Veterinary Medicine, University of Agriculture and Forestry, Hue University. **Calculated composition.

Chickens, management and experimental design

Two hundred forty crossbred Ri chickens (Ri x Luong Phuong) 4 weeks old were randomly divided into 2 groups as control group and fermented group with four replicates (30 chickens/replicate). They were housed in cages (2m x 2m) for each replicate from the age of 4 to 13 weeks. The control group fed a basal diet (Control), while the treatment group (Fermented) fed a maize and rice brain fermentation mixed with the other ingredients of the diet. The water and feed have been provided *ad-libitum*.

Sampling and laboratory analyses

At the end of experiment, eight chickens (Fours males and four females) with body weight closest to the average were slaughted for each of the replicates. From the carrcass, the breast muscles have been cut to determine carcass, meat quality and amino acids contents. The pH of breast muscles at 15 min and 24h postmortem was estimated by pH metter (model HI99163, Gemany). The color of the breast muscle was determined at 24h postmortem using the Minola Chroma Meter (Model CR400, Japan) according to method discribed by Wanner *et al*. (1997). The CIE system was L* (lightness), a* (redness), b* (yellowness). The cooking and drip loss of the breast muscles were dementrated by using the method described by Schilling *et al*. (2012). Drip loss was evaluated at 48h postmortem based on percentage loss of the breast muscle weight during 24h thawed at 4 °C. To evaluate cooking loss, the meat placed individually in the plastic bags and cooked in the water bath at 80°C in 15 minutes. Cooking loss was determined by measuring the weight of the cooked and uncooked samples.

Dry matter, protein, ash and lipid contents of the feed were analysed at the laboratory of Faculty of Animal Sciences and Veterinary Medicine, University of Agriculture and Forestry, Hue University according the proximateanalysis methods (AOAC,1990). The concentration of amino acid composition in breast muscle was analysed according to the (AOAC, 2000; procedure ID994.12).

Statistical analysis

The data was analysed using SPSS soft ware progam (version 20.0, IBM Corp., NY, USA). The values were given in term of mean and standard error of the mean (SEM). The significance of differences between treatment group and control group were evaluated by the Student's t-Test.

RESULTS AND DISCUSSION

Carcass characteristics

The carcass characteristics of control and fermented groups are presented in the Table 2. The results showed that fermentation of rice bran and maize with SC did not affect carcass chatacteristics ($p>0.05$). These results agree with previous reports that using of SC did not affect the carcass yield of chickens (Chumpawadee *et al*., 2008; Karaoglu and Durdag, 2005). In addtion, SC supplementation in poultry production improved health condition, increased in weight gain, and reduced in mortality rates. Therefore, SC has been suggested to use as probiotic agent to replace the function of antibiotics (Malematja *et al*., 2022; Zhang *et al*., 2016, 2021). However, Fathi *et al*. (2012) demonstrated that using of 1.5 g/kg SC in the feed has increased yield of breast. In addition, Kidd *et al*. (2013) and Aristides *et al*. (2018) reported that the supplementation SC fermentation product increase the thigh and breast meat. The carcass yeild increase in the previous studies may be relevance to supplement of SC that can improve the nutrients digestibility such as DM and protein (Sukaryana *et al*., 2011; Hang *et al*, 2020). These above different findings may be affected by the kind or concentration of yeast used, strain of chickens, basal diet or environmental conditions.

Table 2: Effect of fermented feed on carcass characteristics.

Parameter	Control	Fermented	SEM	p
Live weight (g/bird)	1432.0	1463.5	32.2	0.68
Dressed weight (g/bird)	960.4	1006.5	25.4	0.42
Dressing percentage (%)	67.0	68.8	0.5	0.10
Breast meat (%)	17.5	17.8	2.2	0.19
Thigh meat (%)	25.0	25.2	3.4	0.12
Abdominal fat (%)	2.4	1.9	0.3	0.31
Organs (%)	7.3	6.8	0.4	0.50

Breast muscle quality

The breast muscle quality obtained from control and fermented groups is provided in the Table 3. There was not any significant difference in the level of pH, drip loss, cooking loss, and the color (lightness, redness and yellowness) of the breast muscle between the control group and fermented group (p>0.05). It is wellknown that the glycogen concentration in the meat related to pH and the meat colors (lightness, redness and yellowness) are most importance product standard for the dicision of the consumers. Therefore, these parameters change replexed on meat quality. These results in current study demonstrated that using SC to fermented feed for chickend did not affect on the meat quality (p>0.05). These findings agree with previous report that supplementation of SC is not affect on the cooking loss, water holding capacity, texture and colour of breast muscle of broiler (Pelicano *et al*., 2005).

Table 3: Effect of fermented feed on breast muscle quality.

Parameter	Control	Fermented	SEM	p
pH 15min	6.0	6.1	0.1	0.65
pH 24h	5.7	5.8	0.0	0.23
Drip loss 24h (%)	1.0	0.9	0.2	0.86
Cooking loss 24h (%)	21.9	21.4	0.9	0.82
L* (lightness)	53.8	54.2	1.2	0.88
a* (red)	2.8	2.3	0.4	0.58
b* (yellow)	7.7	8.9	0.5	0.29

Amino acid contents

Amino acids (AA) content in the breast muscle of control and fermented groups are presented in the Table 4. The results shown that the contents of essential amino acids (EAA: Arg, His, Meth, Phe, Thr, Val) and non-essential amino acid (NEAA: Asp, Cys, Glu, Ser, Tyr) of the breast meat were significantly higher in the fermented group than in the control group (p<0.05). Furthermore, total AA in the fermented group were higher than in the control group (p<0.05). However, no effect was observed on Ile, Leu, Lys, Ala, Gly and Pro (p>0.05). These results show that rice bran and maize fermented with SC changed almost AA contents of crossbred Ri chicken meat.

It is well-known that AA are the main precursors of the substances for meat flavour (Bachmanov *et al*., 2016; Delompré *et al*., 2019). Accordingly, Glu is the most importance AA effection on the taste of chicken meat. In addition, Asp, Phe, Thr, Tyr and Ser also are an important AA for umami taste (Ali *et al*., 2019; Huang *et al*., 2011). Furthermore, Meth, His, Ile, Leu, Cys, Phe, Tyr, Try, Thr, Lys, and Val are EAA for human (FAO, 2013). Therefore, improvement of EAA such as Arg, His, Meth, Phe, Thr, Val and NEAA such as Asp, Cys, Glu, Ser, Tyr in the chickens breast meat in the present study would be benefitial for humans such as promoting immune system function, the synthesis of proteins and hormones, muscle growth; stimulating the pancreas to synthesize insulin, and transporting oxygen from the lungs to the various parts, (Wu, 2009, 2013). These findings are similar to previous studies that supplement of probiotics effect on AA content of broiler muscle (Podolian, 2017; Santoso *et al*., 2015; Abdulwahab and Horniakova, 2013; Liu *et al*., 2012; Mahmood *et al*., 2005). In addition, supplement of synbiotic improved some EAA (Leu, Ile, Lys, Meth and His) and NEAA (Arg and Tyr) in the both breast and thigh muscles (Salah *et al*., 2019). These results may induced by the improving of the solubation of the protein and ability of the emulsifying of sarcoplasmic protein of muscles in chickens (Kim *et al*., 2017). Based on aboved findings mention that fermentation of maize and rice bran by SC increased the almost AA contents in the breast muscle, especially, AA related to the aroma and tasty of meat.

Table 4: Effect of fermented feed on breast muscle amino acid contents.

Amino acid (µg/ml of sample)	Control	Fermented	SEM	p
EAA[1]				
Arg	9.69[a]	20.76[b]	0.69	0.001
His	7.67[a]	12.04[b]	0.79	0,01
Ile	3.92	4.18	0.28	0,41
Leu	1.58	1.95	0,38	0,38
Lys	31.79	36.98	2.96	0,15
Meth	2.15[a]	3.79[b]	0.37	0,04
Phe	5.32[a]	3.94[b]	0.62	0,03
Thr	6.38[a]	10.51[b]	0.85	0,01
Val	4.34[a]	7.20[b]	0.49	0.001
NEAA[2]				
Ala	42.63	45.62	5.26	0,6
Asp	20,5[a]	26.39[b]	1.70	0,03
Cys	1.99[a]	3.82[b]	0.53	0,03
Gly	2.09	2.66	0.26	0,1
Glu	8.13[a]	11.06[b]	0.67	0,01
Ser	3.77[a]	7.32[b]	0.52	0.001
Pro	167.49	181.93	6.89	0,1
Tyr	13.02[a]	16.70[b]	0.94	0,02
Total	332.52[a]	396.16[b]	9.08	0.001

[1]EAA: Essential amino acids, [2]NEAA: Non-essential amino acids, Arg: Arginine, His: Histidine, Ile: Isoleucine, Leu: Leucine, Lys: Lysine, Meth: Methionine, Phe: Phenylalanine, Thr: Threonine, Val: Valine.Ala: Alanine, Asp: Aspartic acid, Cys: Cysteic acid, Gly: Glycine, Glu: Glutamic acid, Ser: Serine, Tyr: Tyrosine, Pro: Proline. [a,b] different superscripts in the same row are significantly different ($p<0.05$).

CONCLUSIONS

Fermented of rice bran and maize with SC at 0.5g/kg of feed (a concentration of 10^7cf/g) did not affect on carcass characteristics and muscle quality, but increased proportion of most EAA such as Arg, His, Meth, Phe, Thr, Val and NEAA such as Asp, Cys, Glu, Ser, Tyr in crossbred Ri chicken breast meat. Furthermore, using SC in poultry diet improved gut health, enhanced growth performance increase in growth rate. Therefore, SC has the potential as a agent of probiotic to replace the antibiotic function in poultry production. In further research, it would be appropriate to focus not only on the amino acid contents in the breast but also in the thight.

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NOVELTY STATEMENT

The results of this study demonstrated that fermentation of maize and rice bran by Saccharomyces cerevisiae increased the aroma and taste of chicken meat.

AUTHOR'S CONTRIBUTION

Duong T. Hai, Phan T. Hang, Nguyen T. Thuong, Zábranský Luboš: Conceptualization.
Duong T. Hai, Phan T. Hang: Methodology, investigation, formal analysis, writing original draft preparation.
Duong T. Hai, Nguyen T. Thuong, Zábranský Luboš: Writing review and editing.
Duong T. Hai: Project administration
Duong T. Hai, Zábranský Luboš: Funding acquisition.
All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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