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Utilization of Juice Wastes as Corn Replacement in the Broiler Diet

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Abstract: An experiment was conducted with 80 unsexed broilers of the Arbor Acress strain to determine the capability of a carrot and fruit juice wastes mixture (carrot, apple, mango, avocado, orange, melon and tree tomato) in the same proportion for replacing corn in broiler diet. This study involved a Completely Randomized Design (CRD) with 5 treatments (0, 5, 10, 15 and 20% of juice wastes mixture in diets) and 4 replicates per treatment. Diets were isonitrogenous (22% crude protein) and isocaloric (3000 kcal/kg diet). Measured variables were feed consumption, average daily gain, feed conversion, as well as percentages of abdominal fat pad, carcass, digestive organs (liver, pancreas and gizzard) and heart. Data were analyzed by analysis of variance for CRD. Increasing juice wastes mixture levels in diets increased feed consumption ($p<0.05$) and average daily gain ($p<0.01$), while improving feed utilization efficiency ($p<0.05$). These treatments also affected ($p<0.05$) abdominal fat pad percentage but had no effect ($p>0.05$) on carcass, liver, pancreas, gizzard or heart percentages. In conclusion, up to 20% of juice wastes mixture could be included for the broiler diet to effectively replace up to 40% corn in the diet.

Key words: Average daily gain, feed consumption, feed conversion, juice waste mixture

INTRODUCTION

Conventional feed stuffs which are often available for poultry diets consist of corn, rice bran, soybean meal, coconut meal, fish meal and vitamin as well as mineral supplements. Some of corn, soybean meal and fish meal in Indonesia are still imported from abroad. It resulted in a high cost of diets for poultry. Many attempts have been conducted to reduce the cost of these diets. Feed diversification in the poultry diet is one of many attempts to reduce the cost of feed in the poultry industry. The utilization of waste materials from agricultural or industrial wastes (by-products) is often applied to overcome the problem of feed shortage in poultry industry. Up to 7.5% of olive pulp can be included in the ration of broilers (Rabayaa *et al*., 2001). Zafar *et al*., (2005) found that the apple by-product could be used in broiler diets. Tomato pomace of different processing methods could be included up to 10% in broiler diets without affecting live body weight (Al-Betawi, 2005). Oluremi *et al*. (2006) reported that the dried sweet orange rind could also be used to replace dietary maize in broiler diets at the 15% level. Fruits juice wastes might also be included in poultry diets because they still have the nutrients which are available for poultry. However, there are no data available on the amount of these fruits juice wastes in Indonesia. Based on the survey in Padang city, West Sumatra, it was found that there were at least 40 fruit juice counters which produce approximately 30 kg juice waste/counter/day (total 1200 kg/day). It has not included the juice wastes from restaurants (Mahata, 2008). In addition, the more available juice wastes in this city were from the processing of carrot (*Daucus carotta*), apple (*Mallus sylvestris*), mango (*Mangifera indica*), avocado (*Persea americana*), orange (*Citrus* sp.), water melon (*Cucumis melo L)* and tree tomato (*Cyphomandra betacea* Sendtn.). The results of chemical analysis at the Feed Technology and Industry Laboratory, Faculty of Animal Science, University of Andalas in 2009 indicated that the nutrient content of carrot and fruit juice wastes mixture in the same proportion were as follows: crude protein 8.4%, crude fiber 17.1%, ether extract 6.2%, Ca 0.09% and P 0.01% and beta-carotene 24 ppm (conducted at

Table 1: Amino acid content of juice waste mixture as compared to corn

	Amino acid content (%)	
Amino acids	Corn[1]	Juice waste mixture[2]
Aspartate	-	0.71
Glutamate	-	0.98
Serine	0.37	0.46
Histidine	0.23	0.14
Glycine	0.33	0.54
Threonine	0.29	0.39
Arginine	0.38	0.37
Alanine	-	0.54
Tyrosine	0.30	0.43
Methionine	0.18	0.13
Valine	0.40	0.44
Phenylalanine	0.38	0.37
Iso leucine	0.29	0.34
Leucine	1.00	0.54
Lysine	0.26	0.42
Proline	-	0.68
Cysteine	0.18	0.05
Tryptophan	0.06	0.23

[1]NRC (1994). Nutrient Requirements of Poultry.
[2]Analyzed at Animal Nutrition Laboratory, Texas A&M University, USA in 2009 (as-fed basis)

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Table 2: Composition nutrient and metabolizable energy contents of experimental diets

	Experimental diets				
Ingredients	A	B	C	D	E
Corn	50.00	45.00	40.00	35.00	30.00
Juice waste mixture	0.00	5.00	10.00	15.00	20.00
Rice bran	12.00	12.00	12.00	12.00	12.00
Fish meal	21.00	21.00	21.00	21.00	21.00
Soybean meal	15.00	15.00	15.00	15.00	15.00
Coconut oil	2.00	2.00	2.00	2.00	2.00
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
Crude protein	22.26	22.25	22.24	22.23	22.22
Ether extract	6.52	6.63	6.75	6.87	6.98
Crude fiber	3.40	4.66	5.41	6.17	6.92
Ca	1.16	1.16	1.17	1.17	1.17
P total	0.56	0.56	0.56	0.56	0.56
ME	3035.40	3026.90	3018.40	3009.90	3001.40
Lysine	1.35	1.36	1.36	1.37	1.38
Methionine	0.48	0.48	0.47	0.47	0.47
Threonine	0.87	0.88	0.88	0.89	0.89
Tryptophan	0.23	0.24	0.25	0.26	0.26

West Sumatra Biota Laboratory, University of Andalas in 2009). The results of amino acids analysis of this juice waste mixture at the Nutrition Laboratory, Department of Animal Science, Texas A & M University in 2009 (Wu *et al*., 1997) as compared to corn (NRC, 1994) are depicted in Table 1. The crude protein content of this juice waste mixture is similar to corn (NRC, 1994). The tryptophan content of this juice waste mixture is 4.0 times, lysine 1.6 times, glycine 1.6 times and threonine 1.3 times of the corn. There is no information available on the utilization of carrot and fruits juice wastes mixture in the poultry diets. An experiment was conducted to determine the effects of carrot and fruits juice wastes mixtures in diets on the performance of broilers.

MATERIALS AND METHODS

Preparing juice waste: Juice waste from carrot (*Daucus carotta*), apple (*Mallus sylvestris*), mango (*Mangifera indica*), avocado (*Persea americana*), orange (*Citrus* sp.), water melon (*Cucumis melo L)* and Dutch egg plant (*Cyphomandra betacea* Sendtn.) were dried under sunlight until the water content 14%. Every dried juice waste component were mixed in the same proportion become a juice waste mixture for replacing corn in the diet of broiler.

Experimental animals and diet composition: A total eighty day old chicks of the strain of Arbor Acress were assigned to experimental diets of 5 levels of juice wastes mixtures (0, 5, 10, 15 and 20%) in a completely randomized design with 4 replications. Diets were formulated in iso-nitrogenous (22% crude protein) and iso-caloric (3000 kcal/kg diet) as described in Table 2. Diets and water were provided *ad libitum*.

Data collection: Broiler performance data for feed consumption, average daily gain, feed conversion were collected for 4 weeks experimental period on daily basis, while abdominal fat pad percentage, carcass percentage, liver percentage, pancreas percentage, gizzard percentage and heart percentage were taken at the end of experimental period. One broiler per unit of experiment was slaughter to obtain abdominal fat pad, carcass, liver, pancreas, gizzard and heart percentages.

Statistical analysis: A completely randomized design was adopted to execute this experiment and means showing significant differences in the ANOVA table were compared using the Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS

The effect of juice waste on feed consumption, average daily gain and feed conversion: The mean of feed consumption, average daily gain and feed conversion is depicted in Table 3. The feed consumption and feed conversion of broilers were significantly affected ($p<0.05$) by treatments, while average daily gain of broilers was highly affected ($p<0.01$).

The effect of juice waste on abdominal fat pad, carcass, liver, pancreas, gizzard and heart percentages: Abdominal fat pad and carcass percentages are shown in Table 4. Abdominal fat pad percentage was influenced ($p<0.05$) by treatments. Liver, pancreas, gizzard and heart percentages were not affected by treatments (Table 5).

DISCUSSION

The increase in the level of juice wastes mixture augmented the feed consumption of broilers. This was probably due to the increase in the palatability of diets caused by the acid content in the diet. According to the previous report (Cave, 1984), the addition of propionate

Table 3: Mean of feed consumption, average daily gain and feed consumption of broilers in each treatment

Treatment	Feed consumption (g/head/day)	ADG (g/head/day)	Feed conversion
A	63.08[a]	32.37[a]	1.95[a]
B	63.53[a]	33.21[a]	1.92[ab]
C	69.19[b]	39.06[b]	1.78[bc]
D	69.89[b]	40.26[b]	1.74[c]
E	69.29[b]	39.93[b]	1.74[c]
SE[1]	1.77	1.41	0.05

[1]Standard Error of the Mean.

[a,b]The mean with different superscripts at the same column differs statistically ($p<0.05$)

Table 4: Mean of abdominal fat pad and carcass percentages of broilers in every treatment

Treatments	Abdominal fat pad (%)	Carcass (%)
A	1.41[b]	68.61
B	1.76[a]	70.73
C	1.52[ab]	69.03
D	1.32[b]	68.56
E	1.28[b]	67.53
SE[1]	0.11	1.20

[1]Standard Error of the Mean.

[a,b]The mean with different superscripts at the same column differs statistically ($p<0.05$)

Table 5: The mean of liver, pancreas, gizzard and heart percentages of broilers in every treatment

Treatments	Liver (%)	Pancreas (%)	Gizzard (%)	Heart (%)
A	1.70	0.23	2.49	0.60
B	1.87	0.26	2.56	0.58
C	1.73	0.33	2.45	0.55
D	1.77	0.24	2.56	0.50
E	2.02	0.24	2.27	0.55
SE	0.11	0.05	0.15	0.04

[ns]Non-significantly different ($p>0.05$)

to the diet increased feed consumption of broiler chicks. Increasing in the juice wastes mixture in diets increased the average daily gain of broilers. Some reasons for the increase in average daily gain were the high in amino acids contents in the juice wastes mixture such as tryptophan, lysine and threonine, which are nutritionally essential amino acids for animals (Wu, 2009). According to Bilgili *et al.* (1992) and Edwards *et al.* (1999), broilers are more responsive to high lysine in the diet. Lysine increases the growth rate of broilers (Han and Baker, 1994). Tryptophan and threonine are also necessary for growing chicks (Rosa *et al.*, 2001a,b; Shan *et al.*, 2003). Besides, glycine was also important lately for growing chicks in low quality protein diet (Baker, 2009; Dean *et al.*, 2006). The increase in the level of juice wastes mixture in diets improved the feed conversion or the efficiency of feed utilization of broilers. It indicated that the increase in the average daily gain was not in the same proportion with the increase in the feed consumption. More daily gain was obtained from every unit of feed consumption. It could be related to the high of some amino acids (tryptophan, lysine, threonine and glycine) in juice wastes mixture as compared to corn. Although the content of those amino acids (Table 2) in experimental diets already meets the requirement for broilers according to the current version of the NRC (Wu *et al.*, 1997), one of more of them may play a key role in regulating protein metabolism in skeletal muscle and other tissues. It might be also the influence of other substances such as vitamins in juice wastes mixture which improved the efficiency of feed utilization of broiler. These substances need further investigation. The high in average daily gain resulted in improving the efficiency of feed utilization. The utilization up to 20% of juice wastes mixture in the diet improve the efficiency of feed utilization by broilers. The enhancement of the level of juice wastes mixture in the diet reduced the abdominal fat pad percentage of broilers. The decrease in this abdominal fat pad percentage was due the increase in the fiber content in the diets. Cherry and Jones (1982) reported that the crude fiber in the diet could reduce the fat content of broilers. This crude fiber content also limits the inclusion of juice wastes mixture in the diet. Carcass percentage of broilers was not affected by treatments. Liver, pancreas, gizzard and heart percentages were performed in Table 4. These liver, pancreas, gizzard and heart percentages were also not affected by the increase in the level of juice waste mixture in diets.

Conclusion: Up to 20% of the carrot and fruits juice wastes mixture could be included in broiler diets to effectively replace 40% corn in the diet. High crude fiber content in juice wastes mixture limits its utilization by chickens. Further investigation is necessary to optimize the inclusion of this juice wastes mixture in the broiler diet.

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REFERENCES

Al-Betawi, N.A., 2005. Preliminary study on tomato pomace as unusual feed stuff in broiler diets. Pak. J. Nutr., 4: 57-63.

Baker, D.H., 2009. Advances in protein-amino acid nutrition of poultry. Amino Acids, 37: 29-41.

Bilgili, S.F., E.T. Moran and N. Acar, 1992. Strain-cross response of heavy male broilers to dietary lysine in the finisher period. Poult. Sci., 71: 850-858.

Cave, N.A.G., 1984. Effect of dietary propionic acids on feed intake in chicks. Poult. Sci., 63: 131-134.

Cherry, J.A. and D.E. Jones, 1982. Dietary cellulose, wheat bran and fishmeal in relation to hepatic lipids, serum lipids and lipid excretion in laying hens. Poult. Sci., 61: 1973-1980.

Dean, D.W., T.D. Bidner and L.L. Southern, 2006. Glycine supplementation to low protein, amino acid-supplemented diets supports optimal performance of broiler chicks. Poult. Sci., 85: 288-296.

Edwards, H.M., S.R. Fernandez and D.H. Baker, 1999. Maintenance lysine requirement and efficiency of using lysine for accretion of whole body lysine and protein in young chicks. Poult. Sci., 78: 1407-1411.

Han, Y. and D.H. Baker, 1994. Lysine requirement of male and female broiler chicks during the period three to six weeks post hatching. Poult. Sci., 73: 1739-1745.

Mahata, M.E., 2008. Survey on fruits juice wastes in Padang city, unpublished.

NRC, 1994. Nutrient Requirements of Poultry. Nine Revised Edition. National Academy Press. Washington DC.

Oluremi, O.I.A., V.O. Ojighen and E.H. Ejembi, 2006. The nutritive potentials of sweet orange (*Citrus sinensis*) rind in broiler production. Int. J. Poult. Sci., 5: 613-617.

Rabayaa, E., J.M. Abo Omar and R.A. Othman, 2001. Utilization of olive pulp in broiler rations. An-Najah Univ. J. Res., Vol. 15.

Rosa, A.P., G.M. Pesti, H.M. Edwards Jr. and R.I. Bakalli, 2001a. Threonine requirements of different broiler genotypes. Poult. Sci., 80: 1710-1717.

Rosa, A.P., G.M. Pesti, H.M. Edwards Jr. and R.I. Bakalli, 2001b. Tryptophan requirements of different broiler genotypes. Poult. Sci., 80: 1718-1722.

Shan, A.S., K.G. Steroling, G.M. Pesti, R.I. Bakalli, J.P. Driver and A.A. Tejedor, 2003. The influence of temperature on the threonine and tryptophan requirements of young broiler chicks. Poult. Sci., 82: 1154-1162.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures Statistics a Biometric Approach. McGraw Hill, New York.

Wu, G., P.K. Davis, N.E. Flynn, D.A. Knabe and J.T. Davidson, 1997. Endogenous synthesis of arginine plays an important role in maintaining arginine homeostasis in postweaning growing pigs. J. Nutr., 127: 2342-2349.

Wu, G., 2009. Amino acids: metabolism, functions and nutrition. Amino Acids, 37: 1-17.

Zafar, F., M. Idrees and Z. Ahmed, 2005. Use of apple by-products in poultry rations of broiler chicks in Karachi. Pak. J. Physiol., 1: 1-2.