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# The Effect of Improved Juice Wastes Mixture (IJWM) for Corn Substitution on Broilers' Performance

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**Abstract:** The Juice Wastes Mixture (JWM) is a combination of waste from carrot and some fruits (apple, mango, avocado, orange, melon and tree tomato) in the same proportion after their juices were squeezed for fresh drink. The JWM could be as an alternative potential feed for replacing corn in the broiler diet. The problem of JWM as broiler feed is the high in crude fiber and low in metabolic energy contents. After processing the JWM by soaking in 20% concentration of rice hull ash filtrate for 72 hr (IJWM), its crude fiber decreased, while its metabolizable energy increased. An experiment was conducted to evaluate the utilization of IJWM in broiler diets. The experiment was performed in a completely randomized design with different levels of IJWM (0, 20, 25, 30, 35 and 40%) for replacing corn in the broiler diets. The variables measured were feed consumption, average daily gain, feed conversion, live body weight, abdominal fat pad percentage, carcass percentage, liver percentage and pancreas percentage. Every treatment was repeated 4 times. The results showed that the IJWM influenced the feed consumption, average daily gain, live body weight, feed conversion and abdominal fat pad very significantly ($P<0.01$). Meanwhile, liver percentage and pancreas percentage were not affected by the IJWM. In conclusion, the IJWM could be included up to 40% to effectively replace 80% corn in the broiler diets.

**Key words:** Improved juice wastes mixture, rice hull as filtrate, corn, broiler

## INTRODUCTION

The utilization of waste is one of the alternative solutions to overcome the shortage of feed especially corn in poultry diets. One of the potential waste can be obtained from the mixture of juice wastes of variety fruits. The mixture of juice wastes of some fruits might have a potency to replace the corn for poultry diets. Our last experiment showed that the utilization of juice waste mixture (JWM) from carrot (*Daucus carotta*) apple (*Mallus sylvestris*), mango (*Mangifera indica*), avocado (*Persea americana*), orange (*Citrus* sp.), melon (*Cucumis melo L)*, dan Dutch egg plant (*Cyphomandra betacea* Sendtn.) in the same proportion could be included up to 20% in the broilers' diet to effectively replace 40% corn (Rizal and Mahata, 2009).

The problem of JWM as broiler's diet is the higher crude fiber content (17.1%) (Rizal *et al*., 2010). Results of fiber analysis by using Van Soest method (1980) in dry matter basis indicated that the concentrations of Neutral Detergent Fiber (NDF) of JWM was 39.24%, Acid Detergent Fiber (ADF) was 27.91%, cellulose was 13.96%, hemicellulose was 11.33%, lignin was 13.50% and crude protein was 8.4% (in dry matter basis), while metabolizable energy was 1772 kkal/kg (Rizal and Mahata, 2009). The protein content of JWM was similar with crude protein content of corn (8.5%) (NRC, 1994).

Some processing of JWM for improving its's nutrient quality especially for decreasing it's crude fiber content were performed in our last experiment. The processing of JWM by steam pressure in Autoclave 15 psi pressure, 121°C, for 30 minutes decreased the crude fiber of JWM from 13.36 to 12.02% (Mahata *et al*., 2012), while through fermentation by using *Trichodherma viride* with inoculum dosage 7% and incubation time for 5 days, decreased the crude fiber of JWM from 17.10 to 12.23% (Rizal *et al*., 2012).

The rice-hull ashed filtrate is an alkali solution which was a cheaper and easier method for decreasing the crude fiber in agriculture waste for animal feed. This method is not harmful for animal health. Abbas (1984) used the rice-hull ashed filtrate for decreasing the crude fiber of rumen content. Mirzah (2006) found the decreasing of chitin content of shrimp waste when treated by rice-hull ashed filtrate. We also performed the JWM by soaking it in rice-hull ashed filtrate for 72 hours incubation with concentration of rice-hull ashed filtrate on 20%. This treatment declined the crude fiber of JWM from 17.10 to 12.70%, improved the crude protein from 8.40 to 12.22% (as feed basis), increased the metabolizable energy from 1747 to 2117 kkal/kg, nitrogen retention from 59.99 to 67.57% and improved the nutritive values of some amino acids profile (Rizal *et*

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*al*., 2010). The JWM which was processed by rice-hull ashed filtrate we named it as Improved Juice Waste Mixture (IJWM). To know the effect of IJWM as poultry feed, on the performance of broilers, we conducted an experiment by using IJWM for corn substitution in broiler's diet.

## MATERIALS AND METHODS

**Chicken:** Two-week old of 120 broiler chicks, Arbor Acress strain, used in this experiment

**IJMW preparation:** IJMW was prepared by drying and grinding the mixture of JWM from carrot, apple, mango, avocado, orange, melon and tree tomato in the same proportion after their juices were squeezed. Further more the JWM in powder form was soaked in 20% of rice hull ash filtrate for 72 hours.

**Experimental design:** The experiment was performed in a completely randomized design with different levels of IJMW (0, 20, 25, 30, 35 and 40%) for replacing corn in the broiler diets.

**Ration formulation:** Rations were formulated iso-protein (22% CP) and iso-energy (3000 kcal/kg ME). The nutrient and metabolizable energy contents of the feedstuffs for rations are shown in Table 1 and ration formulations as well as nutrients and metabolizable energy contents are in Table 2.

**Variables:** The measured variables were feed consumption (g/head/day), average daily gain (g/head/day), feed conversion, live body weight (g/head), abdominal fat pad percentage (%), carcass percentage (%), liver percentage (%) and pancreas percentage (%). Every treatment was repeated 4 times.

**Data analysis:** The data was statistically analyzed by using the analysis of variance of a Completely Randomized Design. The difference among treatments was determined by using Least Significant Difference (LSD) testing according to Petersen (1985).

## RESULTS

**Feed consumption:** Base on statistic analysis, the feed consumption of broilers was significantly affected ($P<0.01$) by treatments. (Table 3).

**Average daily gain:** There was a highly significant affect of IJWM ($P<0.01$) on average daily gain of broiler. The highest average daily gain of broilers occurred in 20% of IJWM in ration (Table 3).

**Feed conversion:** The feed conversion of broiler was highly affected ($P<0.01$) by the treatments. The utilization of IJWM in the diets decreased the feed conversion or improved the efficiency of feed utilization of the broilers (Table 3).

**Live body weight:** The live body weight was significantly influenced by the treatment ($P<0.05$). The increasing of IJWM from 0 to 40% in ration increased the live body weight of broiler (Table 4).

**Abdominal fat pad percentage:** The abdominal fat pad percentage was very significantly influenced by the treatments ($P<0.01$). When the levels of IJWM was increased from 20 to 35% in the diets of broilers, the abdominal fat pad percentage decreased but when the level was increased to 40%, the abdominal fat pad percentage increased again to the same point as the level of 20% (Table 4).

**Carcass percentage:** The carcass percentage of broilers was not affected ($P>0.05$) by the addition of IJWM in the diet ($P>0.05$) (Table 4).

**Liver and pancrease percentage:** The percentage of liver and pancreas of broiler were not affected by IJWM in ration ($P>0.05$) (Table 4).

## DISCUSSION

The utilization of IJWM (20, 25, 30, 35 and 40%) in broiler's diet decreased the feed consumption in comparing with diet without IJWM (0%) (Table 3). This condition showed that IJWM affected the palatability of diet. We predicted that there are some anti-nutrient in IJWM which came from mellon shell and it affected the feed consumption. Ogbe and George (2012) reported that mellon shell contain tannin as much as 15.15%+0.24, phytates 2.05%+0.12 and saponins 1.47%+0.23. In the past, results of several studies showed that the inclusion of high tannin sorghum in poultry diet reduced the feed intake, weight gain and feed conversion efficiency (Ibrahim *et al*., 1988; Shamsaie and Salini, 1992; Reyes *et al*., 2000). Althought, the feed consumption decreased by increasing of IJWM in diet, the average of daily gain increased in comparing with 0% IJWM in diet. This condition explained that the anti-nutrient in IJWM do not affect the average daily gain and IJWM has two important limiting amino acids (Methionine and Lysine) (Table 5) which are very important to increase the average daily gain. Both of Methionine and Lysine and the other amino acids are needed for the growth of broiler, so that the increasing of IJWM in broiler's diet increased the average daily gain. Virtanen and Rosi (1995) reported that the performance of broiler improved when methionine were added to a corn and soy-bean broiler diet. Labadan (2001) reported that total lysine requirement for broiler chicks in 1 to 21 days in order to increased breast muscle yield is 1.32%. However, the

Table 1: Nutrient and metabolizable energy contents of feedstuffs for ration formulation[a]

| | (%) | | | | | |
|---|---|---|---|---|---|---|
| Feedstuffs | Crude protein | Ether extract | Crude fiber | Ca | P | ME (Kcal/kg) |
| Ground yellow corn | 8.60 | 3.90 | 2.00 | 0.02 | 0.01 | 3370.00 |
| IJWM[b] | 12.70 | 5.50 | 12.22 | 1.28 | 0.05 | 2736.00 |
| Soybean meal | 45.00 | 4.90 | 6.00 | 0.32 | 0.29 | 2240.00 |
| Fish meal[c] | 46.53 | 4.15 | 1.05 | 5.17 | 2.08 | 3080.00 |
| Rice bran | 12.00 | 13.00 | 12.00 | 0.12 | 0.21 | 1630.00 |
| Starch* | - | - | - | - | - | 3600.00 |
| Palm oil* | - | 100.00 | - | - | - | 8600.00 |

[a]Scott *et al*. (1982).
[b]Laboratory of Feed Industry Technology, Faculty of Animal Science, University of Andalas (2011).
[c]Noferdiman (2009).
*NRC (1994).

Table 2: Ration formulations and their nutrients (%) and metabolizable energy contents (Kcal/kg) for broilers*

| | Ration formulations | | | | | |
|---|---|---|---|---|---|---|
| Feedstuffs | A | B | C | D | E | F |
| Ground yellow corn | 50.00 | 30.00 | 25.00 | 20.00 | 15.00 | 10.00 |
| IJWM | 0.00 | 20. 00 | 25.00 | 30.00 | 35.00 | 40.00 |
| Soybean meal | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| Fish meal | 21.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| Rice bran | 12.00 | 7.00 | 5.50 | 4.00 | 2.00 | 2.00 |
| Starch | 0.00 | 6.00 | 7.50 | 9.00 | 10.50 | 10.50 |
| Palm oil | 2.00 | 2.00 | 2.00 | 2.00 | 2.50 | 2.50 |
| Total (%) | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Nutrients and energy: | | | | | | |
| Crude protein | 22.26 | 22.09 | 22.10 | 22.07 | 22.03 | 22.24 |
| Ether extract | 7.12 | 6.75 | 6.63 | 6.52 | 6.84 | 6.92 |
| Crude fiber | 3.56 | 4.99 | 5.33 | 5.66 | 5.93 | 6.44 |
| Calsium | 1.16 | 1.35 | 1.41 | 1.47 | 1.54 | 1.60 |
| Phosphor | 0.51 | 0.49 | 0.49 | 0.48 | 0.48 | 0.48 |
| ME | 3035.00 | 2995.00 | 3000.00 | 3008.00 | 3014.00 | 3009.00 |

* Calculated based on Table 1.

Table 3: The effect of treatment on the feed consumption, average daily gain and feed conversion of broilers

| Treatments | Feed consumption (g/head/day) | Average daily gain (g/head/day) | Feed conversion |
|---|---|---|---|
| A (0% IJWM) | 63.04$^{a}$ | 32.54$^{d}$ | 1.94$^{a}$ |
| B (20% IJWM) | 60.91$^{b}$ | 38.45$^{a}$ | 1.60$^{b}$ |
| C (25% IJWM) | 58.72$^{c}$ | 36.67$^{b}$ | 1.60$^{b}$ |
| D (30% IJWM) | 52.23$^{f}$ | 32.80$^{cd}$ | 1.60$^{b}$ |
| E (35% IJWM) | 54.61$^{e}$ | 34.23$^{c}$ | 1.58$^{b}$ |
| F (40% IJWM) | 57.42$^{d}$ | 36.22$^{b}$ | 1.58$^{b}$ |
| SE | 0.23 | 0.49 | 0.02 |

$^{a,b,c,d,e,f}$ Means with different superscripts at different column indicate significantly different (P<0.05). SE: Standard Error of the mean.

Table 4: The effects of treatments on the live body weight, abdominal fat pad percentage, carcass percentage, liver percentage and pancreas percentage

| Treatments | Live body weight (g/head) | Abdominal fat pad percentage (%) | Carcass percentage (%) | Liver percentage (%) | Pancreas percentage (%) |
|---|---|---|---|---|---|
| A (0% IJWM) | 933.00$^{d}$ | 1.20$^{a}$ | 67.78 | 2.11 | 0.24 |
| B (20% IJWM) | 973.75$^{a}$ | 0.94$^{b}$ | 72.00 | 1.99 | 0.26 |
| C (25% IJWM) | 968.75$^{ab}$ | 0.88$^{bc}$ | 70.60 | 1.95 | 0.25 |
| D (30% IJWM) | 937.50$^{cd}$ | 0.80$^{c}$ | 69.28 | 1.80 | 0.24 |
| E (35% IJWM) | 943.75$^{bcd}$ | 0.84$^{c}$ | 70.23 | 1.81 | 0.25 |
| F (40% IJWM) | 962.50$^{abc}$ | 0.88$^{bc}$ | 70.68 | 1.95 | 0.25 |
| SE | 9.39 | 0.03 | 1.61 | 0.09 | 0.02 |

$^{a,b,c}$The means with the different superscript indicate significantly different (P<0.05). SE: Standard Error of the mean.

Table 5: The comparison of amino acids content in Juice Waste Mixture (JWM) to Improved Juice Waste Mixture (IJWM)

| | Amino acids concentration (%) | |
|---|---|---|
| Amino acids | JWM | IJWM |
| Aspartate | 0.71 | 0.79 |
| Glutamate | 0.90 | 0.92 |
| Serine | 0.32 | 0.40 |
| Histidine | 0.13 | 0.17 |
| Glycine | 0.41 | 0.50 |
| Threonine | 0.36 | 0.48 |
| Arginine | 0.31 | 0.34 |
| Alanine | 0.43 | 0.47 |
| Tyrosine | 0.23 | 0.27 |
| Methionine | 0.06 | 0.09 |
| Valine | 0.41 | 0.51 |
| Phenylalanine | 0.31 | 0.39 |
| Iso Leucine | 0.34 | 0.43 |
| Leucine | 0.48 | 0.58 |
| Lysine | 0.34 | 0.42 |
| Proline | 0.50 | 0.54 |
| Cysteine | 0.02 | 0.03 |
| Cystine | 0.01 | 0.02 |
| Tryptophan | - | - |

IJWM : Improved juice wastes mixture
Analyzed at Animal Nutrition Laboratory, Texas A and M University, USA in 2009 (as feed basis).

average daily gain of broiler which consumed 35% of IJWM in diet is the same as with broiler which consumed the diet without IJWM and the factor affected this condition is not clear. The utilization of IJWM (20, 25, 30, 35, and 40%) in diet decreased the feed conversion or improved the efficiency of feed utilization by broiler. However, there is no difference in the feed conversion among the levels of IJWM in diet. Its means that the IJWM could be included up to 40% in broiler's diets to effectively replace 80% of corn.

The improving of feed efficiency of broiler increased their live body weight, it depict that the nutrient quality of diet with IJWM is better than the diet without IJWM and it also supported that the average daily gain increased by increasing of IJWM in diet. The decreasing of abdominal fat pad percentage of broiler is due to the decline of the feed consumption. The low feed consumption will bring to the low energy consumption which in turn will decline abdominal fat pad percentage.

The carcass percentage of broilers in this experiment was not affected by the inclusion on IJWM in diet. The range of carcass percentage was found 67.78 to 72.00%. The carcass percentage range in this experiment was higher than the carcass percentage of broiler which consumed the Juice Waste Mixture (JWM) (67.53 to 70.73%) in our last experiment (Rizal *et al*., 2010). We also found that there was no effect on broiler which consumed the JWM on their pancreas and liver (Rizal *et al*., 2010). In this experiment we also found that the inclusion of IJWM in broiler's diet did not affect the pancreas and liver. It means that the utilization of IJWM is not harmful for broiler.

**Conclusion:** Improved Juice Waste Mixture (IJWM) could be included up to 40% to effectively replace 80% corn in broiler's ration without adverse effect on their performances.

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