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Weight loss in slaughter weight and Primal Cut (PC) of Bali pigs in additional feed base from fermented broiler farm by-products

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Abstract
The research aims to determine the loss of slaughter weight and primal cuts (PC) in Bali pigs to given feed based on fermented broiler farm by-products (BBP). The research used a completely randomized design, with three treatments and five replications (3 x 5). The treatment is, A: Ration with 0% broiler farm by-product, B: 12% broiler farm by-product, C: 24% broiler farm by-product. Using 15 Bali pigs in the grower phase with an average weight of 13.30±0.79 kg. Research variables: Loss of slaughter weight and primal cuts (Boston butt, picnic shoulder, loin, bacon belly, and ham). The results of the research: Addition of 24% BBP (C) to the feed caused a reduction in slaughter weight of up to 4.7%, carcass weight was 4.8% lower than control (A) (p<0.05) and caused a reduction in slaughter weight of up to 18.7% higher than the control group (p<0.05). Treatment group C (24% BPB) caused a decrease in carcass weight (p<0.05), and was only followed by a decrease in ham weight in the grower phase of Bali pigs. The conclusion is: By adding BBP up to 24%, it can reduce slaughter weight, carcass weight and ham weight, as well as increase the slaughter weight loss of Bali pigs in the grower phase.

Keywords: Bali pig, by-product, carcass cut, slaughter weight

Introduction
The final result of pig farming production by maintaining a fattening system is pigs with a weight that is ready to be slaughtered or maximum slaughter weight (SW) (Čobanović *et al*., 2016) [8]. Various efforts have been carried out to increase post-harvest yields, especially final weight, slaughter weight and prevention of loss of yield as a result of the fasting process before livestock is slaughtered. Pigs are very productive as meat producers and continue to experience improvements throughout the rearing process with the aim of increasing yields (Sumardani *et al*., 2022) [18]. The nutritional content of the ration, the environment and handling of pigs before slaughter can affect slaughter weight and overall reduction in slaughter weight (Ariana *et al*., 2022) [2]. The use of cheap conventional feed and the addition of multi-minerals to pig feed can increase performance in general (Sukmawati *et al*., 2022; Witariadi *et al*., 2023; Ariana, 2023) [17, 21, 3].

The lean cut (LC) percentage consists of the amount of meat in the 4 (four) main commercial cuts of ham, loin, Boston butt and picnic shoulder. The assessment of the 4 commercial cuts is used because these carcass cuts contain meat whose quantity and economic value are relatively higher compared to other cuts, while the primal cut (PC) is LC + bacon belly (Soeparno, 2015; Lawrie, 2003) [14, 11]. In Indonesia, primal cut (PC) or 5 commercial cuts of pork carcasses are still required. Commercial carcass cuts need to be considered because they are an indicator of the yield and quality of the pig carcass. Commercial pig carcass cuts consist of 5, namely: boston, shoulder, loin, belly and ham (Soeparno, 2015) [13]. Post-harvest pig farming, in the form of final weight, slaughter and carcass weight, can be influenced by pre-slaughter treatment such as maintenance, feed, breed (Ariana and Bulkaini, 2021) [1]. The fairly high cost of feed (70%-80%) causes pig farmers to look for solutions to g*et al*ternative feed at a cheaper cost or list cost ratio (Ariana, 2023) [3]. It was also conveyed that information on the use of feed ingredients that are relatively cheap and have high nutritional value has been widely carried out with the aim of overcoming the problem of feed costs. Fermentation of agricultural waste as feed additives or alternative feed to maintain and increase production yields, both antemortem data and postmortem data (Bidura *et al*., 2019; Bulkaini *et al*., 2022) [4, 5]. Broiler farming, whether in a closed house, semi-closed house or open house system, in the production

process produces by-products in the form of rejected chickens, dead chickens and litter around the feed area which is scattered with leftover feed during the rearing period. This by-product has great potential as a source of ration ingredients in animal feed, such as mono gastric livestock (especially pigs) and poultry which require protein concentrate as a ration component. A concentrate product based on chicken farm waste that is maintained using a closed house system, hereinafter referred to as Protein Concentrate based on Chicken Farm waste (Ariana *et al*., 2022) [2]. It was also stated that by adding 12 kg of chicken farm waste-based concentrate to the finisher phase landrace pig ration, a reduction in body weight and digestive tract weight was achieved which was almost the same as the control (full commercial concentrate). Ariana (2023) [3] also presented the results of her research which showed that substituting the use of commercial pig feed concentrate with 50% concentrate from chicken farm waste could maintain the performance of landrace pigs and was almost the same as the control using 100% commercial concentrate.

The results of the research above can provide information and facts on pig farms with alternative sources of feed ingredients that are cheap and can maintain production and do not reduce post mortem/postharvest results. Referring to these conditions, the researchers would like to convey information about the effect of providing additional feed based on broiler farm by-products on slaughter weight loss and the fractional value of commercial carcasses or primal cut (PC) of Bali pigs in the grower phase.

Materials and Methods

Balinese pig

Balinese pigs (local pigs from Bali) as material in this research come from the North Bali area and have received approval to be used in research by the Ethics Committee of the Faculty of Veterinary Medicine, Udayana University, Bali, Indonesia with Number: B/101/UN14 .2.9/PT.01.04/2023. 15 Bali pigs with an average weight of 13.30±0.79 kg were reared according to Bali pig rearing standards. At the end of the study, pigs were slaughtered according to pig slaughter procedures, needs and research objectives.

Broiler farm by-product

Broiler farm by-product or "BBP", is a concentrate based on broiler farm by-products in the form of flour which is fermented with an EM-4 fermenter and can be used as a protein source for mixed pig feed rations (Ariana *et al*., 2022[2]). BPB consists of dead-culled broilers and litter meal mixed with feed residues collected during one rearing period. Rejected chickens and dead chickens are chopped, baked in the oven at a temperature of 70 0C for 2 x 24 hours. Once dry, it is ground to make meat flour. Litter flour is obtained from the litter collection around the feed area (10 cm radius around the feeding area), then collected and mixed thoroughly, dried in the sun until air-dry, then ground to become litter flour. The litter flour is then fermented with the fermenter: EM-4 (for 2 – 3 days) with the aim of increasing the nutritional value of BPB (Table 1).

Table 1: Nutrient content of litter meal, rejected broilers and BBP. Content Unit Sample (broiler farming by-products)

		Litter (x 2)	Ayam Afkir (x 1)	BPB (2 : 1)
Water content	%	3,21	6,31	4,24
Dry mater	%	96,79	93,69	95,76
Ash	%	12,95	9,59	11,83
Organic material	%	87,05	90,41	88,17
Crude protein	%	22,42	64,91	37,00
Crude fat	%	5,43	2,41	4,42
Crude fiber	%	16,42	0,27	11,04
BETN	%	39,57	16,52	31,89
Calsium	%	17,61	13,37	16,19
Fosfor	%	0,82	1,12	0,92
Gross energi	Kcal/gram	3.860	5.530	4.422

Note: *Animal Nutrition and Forage Laboratory, Faculty of Animal Husbandry, Unud. 2023

Commercial concentrate produced by PT. Charoen Pokphand Indonesia. Tbk with code: CP-152, is a concentrate as a protein source for mixed pig rations from the grower phase to the finisher phase, with the recommended use being 24% of the total ration or 24 kg in 100 kg of ration (PT. Charoen. Tbk.). The nutritional content of BBP and commercial concentrate CP-152 is shown in Table.2.

Table 2: Nutritional Content of BPB and CP-152*)

No.	Nutrient	BBP (%)	Konsentrat komersial CP-152
1	Water content	4, 2	12, 0 (max)
2	Ash	11, 83	20, 0 (max)
3	Crude protein	37, 00	37, 0 (min)
4	Crude fatt	4, 42	3, 0 (min)
5	Crude fiber	11, 4	8, 0 (max)
6	Calsium	16, 19	3, 0-5, 0
7	Fosfor	0, 92	1, 2-3, 0
8	Gross Energi (k. cal/g)	4.422	3.654

Note: *Proximate Analysis in the Feed and Animal Nutrition Laboratory, Faculty of Animal Husbandry Univ. of Udayana. (2023).

Research design: The research used a Completely Randomized Design (CRD) with 3 (three) treatments and 5 replications (3 X 5). Using 15 Balinese pigs (local pigs) with an average body weight of 13.30±0.79 kg. The duration of the

research is 70 days. The research treatment was feeding in 100 kg of ration as follows:

1. Ration with 0% broiler farm by-product, (0% BBP) (Control)
2. Ration with 12% broiler farm by-product, (12% BBP)
3. Ration with 24% broiler farm by-product, (24% BBP)

The nutritional content of the rations from each treatment is as shown in Table. 3.

Table 3: Nutritional content of rations from each treatment

Content			Treatment	
		A (control)	B	C
Dry mater	%	86, 7099	87, 7276	85, 5874
Water content	%	13, 2901	12, 2724	14, 4126
Ash	%	12, 3087	15, 3184	11, 3000
Organic material	%	87, 6913	84, 6816	88, 7000
Crude protein	%	22, 8568	21, 7816	20, 4079
Crude fiber	%	4, 0143	5, 1731	7, 1471
TDN	%	84, 3244	71, 6065	67, 7626
BETN	%	32, 9265	41, 9301	45, 7625
Gross energi	kcal/g	3.7266	3.1487	3.3261

Note: *Results of Proximate Analysis at the Feed and Animal Nutrition Laboratory, Udayana University (2023).

Research parameters

The research parameters were weight loss of bali pigs which included: final weight, slaughter weight, slaughter weight loss, carcass weight, carcass percentage. The commercial carcass cuts or primal cut (PC) that are sought are: carcass weight, boston butt weight, picnic shoulder, loin, becon belly, and ham in grower phase Bali pigs.

Data analysis

Data were analyzed using analysis of variance (one way Anova), and if there were significant differences between treatments (p<0.05), then continued with Duncan's multiple range test (Steel and Torrie, 2017) [15]. The analysis procedure uses the SPSS program version 23.0.

Results

Slaugther Weight Loss

The weight loss referred to is the weight loss of Bali pigs at the end of the study minus the slaughter weight (the weight of the pig immediately before being slaughtered). Slaughter weight is the weight obtained after 8-12 hours of the Bali pig during the fasting process before being slaughtered (Soeparno, 2015) [15]. The effect of additional 12%-24% BBP in the ration of bali pigs in treatment groups B and C resulted in the final weight being the same as the control group (A) (p>0.05) (Table 4). The addition of 12% BBP in the ration of treatment group B resulted in the same slaughter weight as A (control group) (p>0.05), but the addition of up to 24% BPB (C) resulted in a reduction in slaughter weight of 4.7% when compared with slaughter weight of control treatment group (A) (p<0.05). This was followed by an increase in slaughter weight loss in treatment group C of 3.17±0.50 kg or 18.7% higher loss when compared to slaughter weight loss in the control treatment group (A) (p<05).

Table 4: Slaughter weight loss in bali pigs given BBP in their rations

Treatment	Final weight (Kg)	Slaughter weight (Kg)	Slaughter weight loss		Carcass	
			(Kg)	(%)	(Kg)	(%)
A	42, 22±1, 25[a]	39, 55±1, 10[a]	2, 67±0, 18[a]	0, 06±0, 00[a]	18, 79±0, 50[a]	48±0, 02[a]
B	42,01±1, 43[a]	39, 14±1, 34[a]	2, 87±0, 18[a]	0, 07±0, 00[a]	18, 89±1, 16[a]	48±0, 02[a]
C	40, 96±1, 34[a]	37, 79±1, 07[b]	3, 17±0, 50[b]	0, 08±0, 01[b]	17, 93±0, 47[b]	47±0, 01[b]
SEM	0, 25	0,24	0,14	0, 09	0, 18	0, 88

Note: Values with the same superscript in the same colume are not significantly different (P>0.05).

In treatment group C, the carcass weight was 17.93±0.47 kg or 4.8% significantly lower than the carcass weight of the control group (p< 0.05). By adding 24% BBP to treatment group C, the carcass percentage was 47±0.01%, or 2.1% significantly lower than the carcass percentage in the control group (p< 0.05) (Table 4).

Primal Cut (PC)

Assessment of 4 commercial carcass cuts (ham, loin, Boston butt, and picnic shoulder), because these carcass cuts contain meat with a relatively higher quantity and economic value when compared to other cuts, while primal cut (PC) is LC + bacon belly (Soeparno, 2015; Lawrie, 2003) [14, 11]. Providing 12% - 24% BPB in the Bali pig ration resulted in a carcass weight that was the same as the carcass weight of the control group (A) (p>0.05). This also occurs in carcass cut (PC) parameters. By administering 12% - 24% BBP (treatment groups B and C), the Boston butt, picnic shoulder, loin and becon belly cuts were the same as the control group (p>0.05). In ham slices, with the addition of 12% BPB (B), the weight was the same as the control group ham (p>0.05).

Table 5: Primal Cut (PC)/Kg in bali pigs given BBP.

Treat	Carcase weigh	Boston Butt	Picnic Shoulder	Loin	Ham	Becon Belly
A	18, 79±0, 50[a]	3, 46±0, 28[a]	3, 19±0, 23[a]	3, 27±,09[a]	4, 64±0, 32[a]	4, 23±0, 32[a]
B	18, 89±1, 13[a]	3, 27±0, 18[a]	3, 64±0, 43[a]	3, 69±0, 69[a]	4, 23±0, 37[a]	4, 16±0, 25[a]
C	17, 93±0, 47[a]	3, 55±0, 33[a]	3, 53±0, 22[a]	3, 54±0, 35[a]	3, 42±0, 12[b]	4, 36±0, 17[a]
SEM	0, 19	0, 11	0, 05	0, 07	0, 13	0.15

Note: Values with the same superscript in the same colum are not significantly different (P>0.05).

Giving 24% BBP (group C) significantly reduced ham weight (P<0.05). In treatment group C (24% BBP), the ham weight was 3.42±0.12 kg and was 26.9% smaller compared to the weight of ham in the control treatment group.

Discussion

Slaughter weight loss

In treatment group C, there was a significant decrease in slaughter weight (SW) of 4.7% compared to control (A), an

increase in slaughter weight loss (kg) of 18.7% compared to control and a decrease in carcass percentage of 2.1% compared to control (Table 4.), this is due to the balance of crude protein with gross energy in treatment ration C (24% BPB) of 20.41%: 3.3261 k.cal/g (Table 3). But, the balance of crude protein: gross energy in ration A (control) was 22.86%: 3.7266 k.cal/g. The lower protein and energy content of the ration can influence the formation of lower muscle mass. This directly caused a decrease in ham weight in treatment group C (p<.05). This phenomenon is in accordance with the opinion of Hasan *et al* (2013) [9]; Soeparno (2015) [14]; Lawrie (2003) [11], the growth and development of livestock body parts is influenced by livestock factors before slaughter, such as nutrient content and frequency of feeding, amino acids and the general environment during maintenance. The decrease in slaughter weight and losses in slaughter weight for all treatment groups (Table 4), empty body weight, and carcass weight (CW) was caused by the fact that when the livestock were before being slaughtered/during the fasting process, the process of excretion (elimination) of feces and urine, and this has a direct effect on reducing slaughter weight. During the fasting period, metabolism and other biological processes/functions continue to run, even without food intake. This is supported by the research results of Leheska *et al*. (2011) [13], who examined the effect of fasting and long transportation time on meat quality and postmortem muscle metabolism. It was reported that pigs who fasted for 48 hours before slaughter experienced a decrease in fresh carcass weight of 3.6% and an increase in initial pH (45 minutes), but there was no significant change in the percentage of carcass fat. During the delay in slaughtering time, pigs experience stress due to conditions that make the animals uncomfortable. This will contribute to weight loss. Pigs experience stress caused by environmental factors including fasting before slaughter.

This is in line with the opinion of Gomes *et al*, (2020) [10], who report that stress when livestock are fasting can be caused by: (a) psychological factors, for example the inability of livestock to show natural behavior patterns, fear, (b) environmental factors. In general, all of these treatments include handling livestock before slaughter (pre-slaughter treatment), whether carried out intentionally or unintentionally. Delaying the slaughter time accompanied by fasting causes weight loss, this is in accordance with the opinion of Lawrie (2003) [11], that fasting in finisher pigs can loss body weight by 4% every day.

The most important in fasting before the slaughter process is that the pigs have experienced a rest process for 12 hours before being slaughtered, ensuring that the Cori cycle runs well, namely the formation of lactic acid in the active muscles which is converted into glucose in the liver (Soeparno, 2015; Sumadi *et al*, 2023) [14, 19].

The research results presented by Cuibi Huang *et al*. (2021) [7], in livestock that during fasting biochemical processes occur that require sufficient energy reserves. Energy is obtained by breaking down carbohydrate (glycogen), fat and protein reserves. Energy depots are in muscle and adipose tissue, so that delaying the slaughter time causes a decrease in the weight of muscle tissue (meat), fat, and overall can reduce carcass production, such as slaughter weight and empty body weight.

Primal Cul (PC)

Lean cut (LC) or 4 commercial carcass cuts consisting of the amount of meat in the 4 (four) main commercial cuts of ham, loin, Boston butt and picnic shoulder. The assessment of the 4 commercial cuts is used because these carcass cuts contain meat whose quantity and economic value are relatively higher compared to other cuts, while the primal cut (PC) is LC + bacon belly (Soeparno, 2015; Lawrie, 2003) [14, 11]. In Indonesia, primal cut (PC) or 5 commercial cuts of pork carcass have economic value. The commercial carcass cut or primal cut needs to be considered because it is an indicator of the yield and quality of the pig carcass. Commercial pig carcass cuts consist of 5, namely: boston butt, picnic shoulder, loin, becon belly and ham (Soeparno, 2015) [14].

The carcass weight was the same (treatment groups A, B) as the control group carcass weight (A) (p>0.05) (Table 5), because the slaughter weight in treatments A and B was the same (p>0.05). The significant decrease in barcass weight in treatment C was due to the lower protein and energy content of the control diet. Differences in amino acids and nutrient content of the ration will have an impact on performance (Sumadi *et al*, 2023) [19]. Carcass percentage is the ratio of carcass weight to slaughter weight multiplied by 100% (Soeparno, 2015) [14]. The significant decrease in carcass weight in treatment group C was not followed by a decrease in the weight of boston butt, picnic shoulder, loin and becon belly (p>0.05), and was only followed by a decrease in ham weight (p<0.05) (Table 5.). This was caused by the protein and energy content in treatment ration C being lower than ration A (control). Amino acids and protein in the ration will influence the growth of muscle tissue and additional muscle mass. The energy in the ration causes an increase in energy accumulation in fat, which can then affect ham muscle mass (Lawrie, 2003; Soeparno, 2015) [11, 14]. This statement caused the weight of the ham in treatment group C to be significantly lower than the weight of the ham in treatment group A (control) (p<0.05). So the decrease in carcass weight in group C was also caused by a significant decrease in the weight of the ham cut.

Conclusion

The research conclusion is: The addition of up to 24% broiler farm by-product (BBP) causes a decrease in weight loss parameters in: slaughter weight, slaughter weight loss, carcass weight and carcass percentage. In the primal cut (PC) parameters, the addition of 24% BBP only caused a decrease in the ham weight of Bali pig in the grower phase.

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