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The impact of substituting waste flour from a broiler farm for commercial concentrate on production performance and edible offal of landrace pig

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Abstract
The goal of the study was to determine how landrace pigs' production performance and edible offal would be affected by switching from commercial concentrate to waste flour from broiler farms (WFBF). There were three treatments and five replications in the study's fully randomized design. “The treatments were, A: using 24% commercial concentrate and 0% WFBW, B: 12% commercial concentrate and 12% WFBF, C: 0% commercial concentrate and 24% WFBF”. Research variables: Production performance and edible offals of landrace pigs. The outcomes: The production performance of landrace pigs was unaffected by replacing commercial concentrate with 50% WFBF from the control. The production performance had been severely lowered by switching to 100% WFBF. The weight of the edible offals was unaffected by replacing commercial concentrate with 50% to 100% WFBF. Conclusion: While 100% WFBF can replace commercial concentrate, it won't have an impact on the weight of the edible offals.

Keywords: Landrace pig, WFBF, performance, edible offal

Introduction
An important goal in the pig farming industry is the performance of the good in the production of pigs.

Because the quality and quantity of non-carcass products have a significant impact on the evaluation of the carcass percentage, post-harvest production, non-carcass products, really needs to be taken into consideration (Soeparno, 2015) [25]. Pigs are particularly productive for meat producers, and management systems for maintenance, feeding, and reproduction are continually being improved with the goal of boosting productivity (Pramudita *et al*., 2021; Sumardani *et al*., 2022) [17, 27].

The performance and composition of the carcass, as well as the non-carcass weight, of pigs before slaughter can be influenced by their nutritional content, genetics, and environmental factors (Čobanović, 2016; Ariana *et al*., 2022) [8, 2]. There is a ton of information about initiatives tremendous enhance pig performance. Male Bali duck performance, particularly ultimate weight and daily weight increase, can be significantly improved (P0.05) by a diet that balances protein and energy (Alit Udayana *et al*., 2020) [4]. The inclusion of many minerals and the use of standard feed Adding (Pig_nox) to pig feed can enhance performance in general (Partama, 2019; Sorhue, 2021; Sukmawati *et al*., 2022) [16, 24, 22]. “Maintenance practices, such as feed and livestock age, might impact appearance (Warmadewi *et al*., 2020) [28]”. It is a proven fact that organs from animals, such as the digestive system, still have economic significance in Indonesian society, particularly in Bali ("edible offals"). After the carcassing process, the leftovers from animal slaughter are known as offals or non-carcasses. “Internal organs (edible offal and an edible offal) make up internal offal, whereas external organs (edible offal and an edible offal) make up external offal (Soeparno, 2015; Lawrie, 2003) [25, 12]”. hese organs will vary in size as a result of the nutrition given, the environment, and genetics (edible offal). This may be the case because pre-slaughter care, including maintenance, feeding, and breeding, can affect yield, meat quality, and non-carcass values like offal (Ariana and Bulkaini, 2021) [1]. Feed costs are relatively expensive in the pig farming industry (70–80% of total costs). Due to these circumstances, pig farmers are looking for ways to find cheaper alternatives to their current feed sources (Chempaka Putri *et al*., 2017) [7].

Researchers have looked into feed ingredients with excellent nutritional content that are very inexpensive. Agricultural waste used as an alternative or feed addition can increase production efficiency and carcass and non-carcass quality (Bulkaini *et al*., 2022; Sukadani *et al*., 2022) [6, 23]. "In grower to finisher animals, supplementing with plant essential oils can enhance growth, performance, and meat quality pigs (Cuibi Huang *et al*., 202 1 [9]".

Hong Sun *et al*., 2023) [11]. "Closed-house broiler cages are cages with closed systems that can offer biological safety, such as avoiding contact with environmental factors that could cause illness and stress in broiler farms". The temperature inside closed-house cages is kept lower than the outside temperature using ventilation controls and completely automatic thermo regulators. "Humidity, wind speed, and light entering the cage can also be optimally controlled, creating a comfortable environment for the chickens and reducing stress on broiler chickens" (Suasta *et al*., 2017) [21]. "Both closed-house and open-house broiler farms have by-products that can include rejected chickens and litter that contains leftover feed. This by-product holds great promise as a source of protein in other livestock rations, such as those for monogastric animals (particularly pigs), which protein need concentrate as a ration component. Henceforth referred to as Protein Concentrate Waste-based Pultry Farming, Produck Concentrate from Waste-based Chicken Farm (Ariana *et al*., 2022) [3]".

The findings mentioned above can serve as motivation for research into how landrace pig performance and edible offal are affected when commercial concentrates are replaced with waste flour from broiler farms (WFBF).

Materials and Methods

Animal ethics approval: The Ethics Committee of the Faculty of Veterinary Medicine at Udayana University, Bali, Indonesia, gave its approval for the use of landrace pigs as research subjects with Number: B/272/UN14.2.9/PT.01.04 /2022. Pigs used as research subjects were raised in accordance with pig husbandry guidelines and given food and drink as required. Pigs were slaughtered at the conclusion of the study in accordance with the protocol for killing pigs, the needs, and the study's objectives.

Waste Flour from Broiler Farm (WFBF): Waste Flour from Broiler Farm (often abbreviated as "WFBF") is a concentrate protein source manufactured from the litter and flour of dead broiler chickens along with leftover feed. After being diced, the rejected and dead broilers were cooked for two consecutive 24-hour periods at 70 °C. To manufacture meat flour, it must first be dried before being ground. Litter flour is made by collecting litter from collections around the feed area, mixing it equally, letting it air dry in the sun, and then grinding it. In order to boost the food's nutritional content, fermentation is done using an EM-4 fermentor.

Table 1: Nutritional cintent of WFBF

1	Water content	11,3
2	Ash	10,4
3	Crude protein	39,7
4	Crude fat	4,8
5	Crude fiber	8,4
6	Calsium	15,2
7	Fosfor	1,2
8	Gross Energi (k.cal/g)	5.110

Note: "Proximate Analysis at the Animal Feed and Nutrition Laboratory, Faculty of Animal Husbandry Univ. Udayana. (2021)".

Two parts litter flour and one part rejected broiler meat flour make up "WFBF" flour. Table "1 lists the nutritional components of WFBF. The business concentrate created by PT. Charoen Pokphand Indonesia. Tbk with code: CP-152 is a concentrate that is recommended to be used at a rate of 24% of the total ration, or 24 kg in a 100 kg diet, as a source of protein for mixed pig rations from the growth phase to the finisher phase" (PT. Charoen. Tbk. 2022) [18].

Research design

The research study was a fully randomized design with 3 (three) treatments and 5 replications (3 X 5). The average body weight of the 15 pigs utilized in the study was 63.42 ±2.39 kg. The study lasted 90 days (70 days for upkeep plus 20 days for data analysis). 103.92± 8.51 kg is the slaughter weight for pigs. In this investigation, the treatment consisted of formulating 100 kg of food as follows:

A: 24 kg commercial concentrate + 0 kg WFBF. (Control)
B: 12 kg commercial concentrate + 12 kg WFBF.
C: 0 kg commercial concentrate + 24 kg WFBF.

Table 2: Formulation of research rations and nutritional content.*)

Treatment (kg)	Material		
	(Control) A	B	C
Consent rate CP.152	24	12	0
WFBF	0	12	24
Polard	35	35	35
Corn	40	40	40
Pig Mix	1	1	1
Total	100	100	100
Water			
%	13,2901	12,2724	14,4126
Ash	%	12,3087	15,3184
Org. matter	%	87,6913	84,6816
Crude protein	%	22,8568	21,7816
Crude fiber	%	4,0143	5,1731
Crude fat	%	4,6036	5,5244
TDN	%	84,3244	71,6065
BETN	%	32,9265	41,9301
Gross energy	kcal/g	3,7266	3,1487

Note: A: 24 kg commercial concentrate + 0 kg WFBF/control B: 12 kg commercial concentrate + 12 kg WFBF.
C: 0 kg commercial concentrate + 24 kg WFBF *) Analysis at the Animal Feed and Nutrition Laboratory, Fapet. Unud. (2022)

Research parameters

The performance of landrace pigs was measured based on their beginning and ultimate body weights, average daily gains (ADG), slaughter weights, chest girths, heights, and lengths. The internal offal measurements of landrace pigs include the weights of the heart, liver, lung, kidney, stomach, small intestine, and large intestine.

Data analysis

"One way ANOVA was used to examine the research data, and Duncan's multiple range test was used to determine whether there were any significant differences between the treatments (p<0.05)" (Steel and Torrie, 2017) [26]. Version 23.0 of SPSS is used for the analysis process.

Results

Performance

As shown in Table 3, "switching from commercial concentrates to waste flour from broiler farms (WFBF) has an

impact on the performance of pig production, including initial body weight, final body weight, slaughter weight, average daily gain (ADG), chest girth, body height, and body length". Treatment B produced same end body weight, slaughter weight, weight gain, and chest circumference when commercial concentrate was substituted with WFBF 50% of the control (12 kg) (p>0.05). 100% WFBF (24 kg) of commercial concentrate may be substituted in treatment C considerably decreased performance in terms of output, particularly in terms of pigs' final body weight, slaughter weight, average daily gain (ADG), and chest girth (p<0.05). Body height and body length of landrace pigs did not significantly change when commercial concentrates up to 100% WFBF (24 kg) were substituted (p>0.05).

Table 3: "Effect on performance and output of landrace pigs of substituting commercial concentrate with waste flour from a broiler farm".

Treatment	Initial W	FBW	ADG	SW	CG	BH	BL
	Kg	Kg	Kg	Kg	Cm	Cm	Cm
A	63,00±1,6a	109±3,4a	0,66±0,1a	109±3,5a	106,3±2,1a	64±1,7a	75±4,4a
B	63,75±1,3a	110±0,8a	0,66±0,1a	108±0,8a	106,5±1,7a	65±1,9a	79±2,9a
C	63,51±4,1a	105±9,4b	0,61±0,2b	99±14,2b	99,8±8,3b	62±4,7a	74±4,4a
SEM	1,12	1,21	0,51	2,21	1,67	1,11	1,34

No significant difference is indicated for values with the same letter in the same column (p>0.05). Final Body Weight (FBW) Average Daily Gain (ADG), SW: slouched weight BH: Body high, BL: body length, and CG: chest girth.

Edible offal

"On the edible weight of offals, which comprises heart weight, liver weight, lung weight, kidney weight, stomach weight, small intestine weight, and large intestine weight, the effect of substituting waste flour from broiler farm (WFBF) for commercial concentrate is assessed, as shown in table 4". Substitution resulted A cardiac organ weight of 0.93 0.1 kg and the same weight as the control were obtained from a concentrate commercial containing WFBF at 50% of the control (12 kg) (p>0.05). In treatment group C, commercial concentrate was substituted with 100% WFBF (24 kg), resulting in a heart weight of 0.98 0.2 kg, which is nearly the same weight as treatment groups A and B (p>0.05).

Table 4: Effect on the edible offal weight of landrace pigs (kg) of substituting commercial concentrate with waste flour from broiler farms.

Treatment	Hert	Liver	Lung	Kidney	Stomach	Small Int.	Large. Int.
A	0,80±0,8a	1,57±0,1a	0,53±0,1a	0,31±0,04a	0,68±0,5a	1,43±0,1a	1,51±0,1a
B	0,93±0,1a	1,61±0,2a	0,54±0,1a	0,23±0,02a	0,62±0,2a	1,47±0,4a	1,45±0,2a
C	0,98±0,2a	1,48±0,2a	0,49±0,2a	0,22±0,04a	0,53±0,1a	1,26±0,1a	1,24±0,4a
SEM	0,23	0,91	0,35	0,14	0,42	0,65	0,89

Note: "Values with the same letter in the same colume indicate no significantly different (p>0.05)".

Substitution of commercial concentrates with 50% to 100% WFBF (treatment group B-C) showed no discernible impact on the weights of the liver, lungs, small and large intestines (p>0.05).

Discussion

Performance

The replacement of commercial concentrates with WFBF was insignificant for any of the pig performance parameters (in treatment groups A and B) due to the nearly identical nutrient content in treatment rations A and B (Table 2), particularly in terms of crude protein, crude fat, and gross energy (Table 3). "The environmental parameters in the study cages, such as the breed, initial weight of the pigs, and temperature-climate in the study cages, were practically the same, in addition to the nutritional content elements that were almost the same (A and B)". The findings of this study are consistent with those provided by Lothong *et al*. (2022) [13], who claimed that climate has a significant impact on how well back yard-raised pigs perform. "The performance of the pigs was considerably decreased when commercial concentrate was substituted with 100% WFBF from control (24 kg) (treatment group C), particularly in final body weight, slaughter weight, average daily gain (ADG), and chest growth (p<0.05)". This was due to the full/100% WFBF (24 kg) and 0% or no commercial concentrate used in the rations in treatment C (Table 2). This may also be a result of commercial concentrates having a higher and more complete concentration of micro minerals and critical amino acids. Pigs' performance will be impacted even by a modest nutritional imbalance in their diet. The findings of this study support Partama (2019) [16] assertion that adding 0.1–0.3% multi-mineral (Pig-nox) to pigs' basal rations can greatly increase performance, particularly in terms of final body weight, weight gain, and FCR. According to Gomes and Code (2020) [10], adding 6% dragon fruit peel flour to the diet could result in pigs gaining more weight each day and at a higher ultimate body weight (p<0.05).

Edible offal

There were no appreciable differences in the weights of the stomach, small intestine, big intestine, kidney, lung, heart, or kidney between the three treatments (p>0.05). "This is due to the fact that some of these organs, including the heart, kidneys, lungs, and liver, are essential organs whose development during the growth phase is independent of the nutrition levels in the digestive tract and the muscle fibers of the internal organs". Apart from being supported by nutrients from food substances, The body's mechanism of breaking down protein and energy can also contribute to the development of various essential organs' cells during the growth stage, keeping the development of these cells consistent with the pig's growth. "This is in line with basement of Merta *et al*. (2014) [15], who claimed that the number of cell fibers of a number of internal organs that are early mature in nature develop quickly during the prenatal period and remain relatively constant from birth to the growth period". According to McGlone and Pond (2003) [14], some internal organs that are essential to life develop earlier than other organs, For instance, the heart and other essential organs begin to develop at around 20 to 21 days after conception.

These organs develop more slowly than the stomach and reproductive systems after birth.

WFBF contains about the same amount of nutrients as commercial concentrates, particularly in the areas of crude protein, crude fat, and gross energy (Table 2). This could account for the non-significant results of the substitution of commercial concentrates with 50% to 100% WFBF from the control group (p>0.05). The findings of this investigation support Raharja *et al*.'s (2013) [20] assertion that extending the time of pig slaughter had no substantial impact on the weight of the animals' internal organs. "The net weight of the digestive system, stomach, small intestine, and large intestine in that study was considerably different from that of this study, which differs from that of Merta *et al*. (2014) [15], which added rice husk to hotel waste-based meals. Additionally, it was claimed that this was because the amount of rice husk in the diet had increased, which increased the capacity of the stomach, small intestine, and large intestine, among other parts of the digestive tract". The weight of the stomach, small intestine, and large intestine of pigs increases due to a rise in the capacity of these organs. This is connected to the way that the muscle fibers of the small intestine and the large intestine function, which is crucial for the fermentation of fiber towards the end of the digestive tract. By replacing tofu dregs for commercial concentrates, Puger *et al*. (2015) [19] published additional research findings that could drastically alter the organ weight of purebred pigs. Food molecules, notably fiber, that will pass through the small intestine and large intestine temporarily store in the stomach (Al-qazzaz *et al*., 2023) [5].

Conclusion

This study found that the performance of landrace pigs was unaffected by, or comparable to, the control when commercial concentrate was substituted for WFBF 50% of the control (12 kg/100 kg ration). "The productivity of landrace pigs can be decreased by substitution of up to 100% WFBF". The weight of the edible offals of landrace pigs was unaffected by replacing commercial concentrate with 50%-100% WFBF (12 kg-24 kg/100 kg feed).

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