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Substitution of Commercial Feed with Fermentation of Coffee Skins Using Local Micro-Organisms for the Reproduction Rate of Landrace Pigs

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Abstract
The development of pig livestock is supported by feed that has a high nutritional content, namely fermented coffee skin which can increase livestock reproduction to increase livestock production and productivity. The aim of the study was to evaluate the substitution of fermented coffee skins on the reproduction of landrace sows and at what level the substitution of fermented coffee skins affected the reproduction of landrace pig. This research method used a completely randomized design (CRD) with four treatments T0 = 100% Commercial Feed, T1 = Commercial Feed (95%) + 5% Fermented Coffee skin, T2 = Commercial Feed (90%) + 10% Fermented Coffee skin, T3 = Commercial feed (85%) + 15% fermented coffee skin. Each treatment was repeated 3 times so that there were 12 experimental livestock units. The results showed that substitution of fermented coffee skin had no significant effect on estrus, namely 2.67-3.00 days, estrus cycle 19.67-20.67 days, birth weight 1.32-1.65 kg, and mortality 0.33-1.67%, but 5% fermented coffee skin substitution had a significant effect on gestational age, namely 113.67 days, litter size of 11 tails, weaning weight of 8.05 kg. It can be concluded that 5% fermented coffee skin substitution gave the best results on estrous variables, estrus cycle, litter size, birth weight, weaning weight and mortality.

Keywords: *Coffee Skin, Fermentation, Pig, Reproduction*

1. Introduction

Pigs are one of the farm animals developed in various countries, one of which is in Indonesia. Pigs have good environmental adaptability, especially in tropical climates. Pigs are one of the commodities that are easy to develop because they have high adaptability to food and the environment, are able to convert feed into meat, grow fast, and have a high litter size [1]. Along with the increase in population, the need for meat will increase so that pigs need to be well developed to meet the needs of animal protein. Developing pig livestock must be supported by feed with high nutritional value to increase livestock production and productivity in order to meet human needs for meat and gain profits [2]. The growth of pigs or the increase in body size of livestock is one of the parameters to compare whether the growth of pigs is in the good category or not. Livestock growth is supported by feed ingredients that are given to reach body and sex maturity in a short time.

Coffee is one of the plantation crops that has high economic value in Indonesia, both as a by-product in the form of coffee skin [3] and as the most popular drink in the world [4]. The coffee cherries produced in Catur Kintamani Village reach 250 tons/year for wet processing and 25 tons for dry (natural) processing, the coffee skins produced reach 124 tons and can be used as animal feed [5]. Coffee processing produces 55-60% coffee beans and 40-45% coffee skins [6]. Coffee skin contains nutrients including 6.67% crude protein, 39.42% crude fiber,

90.52% dry matter [7]. beside that, there are calcium and phosphorus content needed by livestock [8]. In addition to nutrients found in coffee skin, there are anti-nutritional substances, namely tannins, caffeine, lignin and high crude fiber that have a negative influence on livestock if given in unfermented conditions so it is necessary to ferment to increase nutritional value by converting complex raw materials into simple materials with the help of microbes [9].

Table 1. Nutritional Content of Coffee Skin Fermented With Different Probiotics

Nutrition(%)	Non fermented	*Aspergillus niger*	Yeast tempe (*R.Oryzae*)	Yeast tapai (*S.Cerevisiae*)
Dry matter	88.92	86.86	85.81	86.53
Crude protein	8.76	10.23	10.10	9.53
Gross energi (Kcal/kg)	3892.00	3829.00	3777.00	3802.00
Fat	1.29	1.14	6.58	1.35
Organic matter	91.85	92.04	92.15	92.35
Ash	8.15	7.96	7.85	7.65
Crude fiber	29.65	29.46	27.17	28.85
Calcium (Ca)	0.53	0.42	0.42	0.40
Phosphorus (P)	0.10	0.12	0.10	0.09

Source: (Dinata and Utami, 2019)

Pigs that are fed feed with high nutritional value have good growth, body maturity and sexual maturation more quickly. Pigs that enter sexual maturity are marked by a reproductive cycle that is starting to show where they show symptoms of lust and are ready to be mated either naturally or artificially. The characteristics of lust in pigs are restlessness, screaming, riding on other females if there are several sows in one pen, when ridden by the pig it will be silent and not moving, decreased appetite, mucus coming out of the vagina, vulva swelling and looking red. Every livestock has a different lust cycle. The estrus cycle in pigs ranges from 18-24 days and the gestation period is 114-116 days [11] and ranges from 20.41 days, the estrous cycle is 3.25 days. The size of lambs is 9.75 and the mortality rate is 17.03% [12]. Estrus cycle 18-20 days, 2-3 days long estrus [13]. Birth weight ranges from 1.5-2.5 kg with an average of 1.99 kg [14].

Coffee skin is waste from plantation products that must be used as animal feed so as not to cause various problems to the environment. Wet coffee skin has a fairly high water content, which is about 77% and high water content makes it easier for decay to occur which can cause several environmental problems that result in environmental pollution [15,16]. Coffee skin is an environmental problem because coffee skin still contains caffeine, free phenols, and tannins (polyphenols) which are known to be toxic to the life processes of microorganisms in the soil [17].

Based on this, research was carried out by fermenting natural coffee skin using Local Microorganisms from the Kintamani Bangli Productive Business Unit to increase its nutritional content. High nutritional feed can increase the reproduction of landrace sows.

2. Materials and Methods

This research was carried out for 6 months starting from July-December 2022. The research was carried out in the Chess Productive Business Unit, Kintamani District, Bangli Regency, Bali Province. The results of the analysis of commercial feed ingredients and coffee skins can be seen in table 2, and the content of research rations is seen in table 3. The research design used was a complete randomized design (RAL) with four treatments as follows: "T_0= 100% commercial feed, T_1; Commercial feed (95%) + 5% fermented coffee skin, T_2= Commercial

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feed (90%) + 10% fermented coffee skin, T_3=Commercial feed (85%) + 15% fermented coffee skin. Each treatment was repeated 3 times so that there were 12 experimental livestock units.

The materials and tools used in this study are: Local Microorganisms, molasses, water, coffee skins, pigs, scales, barrels, tubs / buckets and measuring cups. The fermentation process of coffee skin as much as 100 kg, 1 liter of local microorganisms of coffee skin, 1 liter of molasses and 10 liters of water. The ratio of coffee skins used in the fermentation process is 14 kg of 100 kg of coffee skin, 100 ml of 1 liter of local microorganisms, 150 ml of 1 liter of molasses and 2 liters of 10 liters of water. All ingredients are mixed evenly and kept for 2 weeks.

Table 2. Analysis of Commercial Feed and Fermented Coffee Skin

Nutrition (%)	Commercial feed	Fermented coffe skin
Water	11.29	38.13
Dry matter	88.70	61.80
Ash	9.80	14.28
Crude fiber	7.59	18.36
Crude protein	14.61	19.18
Oganic matter	90.19	97.18
Gross energi (Kcal/kg)	4.34	3.52
Calcium (Ca)		0.38
Phosphorus (P)		0.18

Source = Feed and Nutrition Laboratory, Faculty of Animal Husbandry, Udayana University (2022)

Table 3. Nutritional Content of Research Rations

Nutrition (%)	Commercial feed	Substitution 5%	Substitution 10%	Substitution 15%
Water	11.29	12.63	13.97	15.51
Dry matter	88.70	87.36	86.01	84.67
Ash	9.80	10.03	10.25	10.47
Crude fiber	7.59	8.13	8.67	9.21
Crude protein	14.61	14.83	15.06	15.29
Organic matter	90.19	90.53	90.88	91.22
Gross energi (Kcal/kg)	4.34	4.30	4.25	4.21

3. Results and Discussion

3.1 Results

The results of the study of the substitution of fermented coffee skin on the reproduction rate of landrace pig can be seen in Table 4.

Table 4. Substitution of Fermented Coffee Skins to The Reproduction Rate of Landrace Pigs

Description	Average reproductive performance			
	T_0	T_1	T_2	T_3
Estrus (Days)	3.00	2.67	3.00	3.00
Estrus Cycle (Days)	20.00	19.67	20.67	20.67
Pregnancy (Days)	113.33	113.67	113.67	115.67
Litter Size (Tail)	8.00	11.00	10.00	3.67
Birth Weight (Kg)	1.32	1.65	1.34	1.51
Weaning Weight (Kg)	5.44	8.05	5.46	6.20
Mortality (%)	1.67	0.00	0.33	1.33

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Description: T_0 = 100% commercial feed, T_1; commercial feed (95%) + 5% fermented coffee skin, T_2= commercial feed (90%) + 10% fermented coffee skin, T_3= commercial feed (85%) + 15% fermented coffee skin.

Based on statistical analysis, substitution of fermented coffee skins had no significant effect (P>0.05) on estrous time. The 5% coffee skin substitution treatment tended to give the best results at 2.67 days of estrus, which was not significantly different from the 10% and 15% fermented coffee skin substitution treatments with 3 days of estrus. Based on statistical analysis, substitution of fermented coffee skins had no significant effect (P>0.05) on the estrus cycle. The 5% fermented coffee skin substitution treatment tended to give the best results in the estrus cycle of 19.67 days which was not significantly different from the treatment without fermented coffee skin. Fermented coffee skin substitution treatment was 10% and 15% with an estrus cycle of 20 days and 20.67 days.

Based on statistical analysis, substitution of fermented coffee skins had a significant effect (P<0.05) on the duration of pregnancy. The treatment without fermented coffee skin gave a gestation period of 113.33 days which was not significantly different from the 5% and 10% fermented coffee skin substitution treatments with a gestation period of 113.67 days respectively, but significantly different from the 15% fermented coffee skin substitution treatment with gestational age 115.67 days. Based on statistical analysis, substitution of fermented coffee skins had a significant effect (P<0.05) on the number of piglets. The 5% coffee skin substitution treatment tended to give the best results in the number of piglets, namely 11 pigs and was not significantly different from the 10% coffee skin substitution treatment, namely 10 pigs and the treatment without 8 fermented coffee skins. However, it was significantly different from the 15% coffee skin substitution treatment namely 3.67 heads.

Based on statistical analysis, the substitution of fermented coffee skin has no real effect (P>0.05) on birth weight. The 5% fermented coffee skin substitution treatment tends to give the highest results at birth weight which is 1.65 kg which differs not markedly with 15% substitution treatment, 10% substitution treatment and fermented coffee skinless treatment weighing 1.51 kg, 1.34 kg and 1.32 kg respectively. Based on statistical analysis, fermented coffee skin substitution has a noticeable effect (P<0.05) on weaning weight. The 5% fermented coffee skin substitution treatment gave the highest result of 8.05 kg in real contrast with the 15% fermented coffee skin substitution treatment, 10% coffee skin substitution treatment and coffee skinless treatment weighing 6.20 kg, 5.46 kg and 5.44 kg respectively. Based on statistical analysis, substitution of fermented coffee skins had no significant effect (P>0.05) on mortality. The 5% coffee skin substitution treatment tends to give the best results on mortality, namely 0%. Meanwhile, 10% fermented coffee skin substitution resulted in 0.33% mortality, 15% mortality 1.33% substitution and 1.67% mortality without coffee skin substitution.

3.2 Discussion

3.2.1 Estrus

Based on the results of statistical analysis, the variable length of estrus was not significantly different (P>0.05) between the treatments T_0, T_1, T_2 and T_3. However, T_1 tended to give the best results at 2,67 days of estrous age compared to other treatments. This is caused by nutrition, environment, parental conditions and genetics. Nutrition has an influence on estrus, where livestock given feed with low nutrition will occur quiet lust or silent heat because reproductive physiology does not function optimally, or lack of estrogen hormone in the blood that stimulates estrus and vice versa. This is reinforced by [18] which states that nutrition can influence the reproduction of the hypothalamus-pituitary-ovary of pigs through neuroendocrine pathways and/or variations in metabolic clearance of reproductive hormones.

Inhibition of gonadotropin release due to malnutrition and damaging gonadotropin-releasing hormone (GnRH) while refeeding restores luteinizing hormone (LH), and nutrients affect follicle growth and maturation. Nutrition affects follicle development before ovulation

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[19] and stressful brood conditions also affect follicle development and ovulation [20]. Ovulation is influenced by changes in feed intake, body condition and body weight. Nutrient effects on circulating FSH concentrations remain the same; it has also been stated that nutrients (glucose, amino acids) and nutrient-related metabolites (insulin growth hormone, IGFs and IGFs binding proteins) that indirectly affect the ovulation response to nutrients, may take place at the ovarian level decreasing the amount of FSH required to support gonadotrophin-dependent follicles [21]. High-energy feeding shortly before estrus increases ovulation rates. Low energy intake during maintenance results in fewer ovulation than high energy levels [22]. The completeness of nutrients in animal feed will be able to accelerate puberty, the first estrus after childbirth, maintain pregnancy, the weight of the child born, the weight of the child after weaning and maintain the condition of the mother during lactation [23]. Feeding fermented coffee skin concentrate added with feed additives can shorten the distance of lust or estrus in Bali cattle after giving birth [24]. Giving fermented coffee skin waste with local microorgnism from coffee coolie waste in cattle, goats and pigs shows a very high response of livestock to consume it [5]. Fermented coffee skin with a high ash content is a factor affecting the deliciousness of food [25]. Using up to 10% coffee skin in ewe feed for 16 days before breeding improved oxidative status without adverse effects on estrus and pregnancy [26]. Coffee grounds supplementation 25% did not affect estrus, estrous response, and proliferation in ewe [27].

3.2.2 Estrous Cycle

The results of statistical analysis of estrous cycle variables had no real effect ($P>0.05$) between T_0, T_1, T_2 and T_3 treatments. However, the T_1 treatment tended to give the best results of 19.67 days and was not significantly different from T_0 with an estrus duration of 20 days, T_2 and T_3 with an estrus length of 20.67 days. This tends to be influenced by the nutritional content contained in the feedstuffs. Feed ingredients that have high nutritional content affect the estrus cycle that produces the hormone estrogen in the blood so that lust or estrus will be clearly visible and vice versa if the estrogen hormone in the blood is a little lust or estrus is not clearly visible. This is related to the physiological organs of livestock reproduction where nutrients play an important role in the reproductive cycle that is able to produce follicles and develop until ovulation. This is supported by [28] which states that the variation in the estrus cycle is caused by differences in female individuals, livestock breeds, age, hormones, seasons, feed and environment. Explains that excess or lack of nutrition can cause pigs to have a poor reproductive cycle [29]. In sows, malnutrition can affect follicle growth, lower ovulation rates, delay puberty and return to estrus after weaning and inhibition of gonadotropin release due to malnutrition [18].

The estrus cycle of pigs lasts 18-22 days, 20.42 ± 2.36 days, 17.8 ± 1.40 days (30, 31, 32). The estrus cycle in pigs lasts 18-24 days. It consists of a follicular phase of 5-7 days and a luteal phase of 13-15 days. During the follicular phase, small antral follicles develop into large follicles pre-ovulation. As a polytocous species, pigs can ovulate from 15 to 30 follicles, depending on age, nutritional status and other factors. During the luteal phase, follicular development is less pronounced, although there may be a considerable turnover from primordial follicles to early antral ones that fail to develop further due to inhibition of gonadotrophic hormones by progesterone [11]. The administration of 25% coffee skin in sheep concentrate did not change the onset of estrus, which occurred 31.61 hours after removal of controlled internal drug release (CIDR) in the control treatment and 34.94 hours in the coffee skin treatment [27]. The 36.2 hours were reported by [33] but greater than the 26.5 hours after CIDR removal [34]. In addition, the addition of 20% coffee skin in the concentrate without significantly reducing milk yield [35].

3.2.3 Pregnancy

Based on the results of statistical analysis, the length of pregnancy variable had a significant effect ($P<0.05$) between T_0, T_1, T_2 and T_3. However, the best results were in the T_0 treatment

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of 113,33 days, which was not significant with T_1 and T_2 with a gestational age of 113.67 days respectively, but significantly different ($P<0.05$) in T_3 with a gestational age of 115.67 days. This is influenced by feed factors and the number of piglets born where a few born piglets will prolong the gestation period and vice versa. This is reinforced by [36] which states that pig farming is influenced by nutritional factors given to livestock.

Duration of pregnancy 111.6 ± 1.50 days [32] the average length of pig pregnancy ranged between 111-114 days [37] and 111-120 days [36]. Also stated that factors that cause differences in pregnancy include unclear intensity of lust and differences in parity [38]. Lust intensity is related to livestock farming where the intensity of lust is less clear making it difficult for farmers to observe the symptoms of lust, insemination time is not right on target, and fertilization does not occur, causing pregnancy failure in livestock.

The completeness of nutrients in animal feed can maintain livestock survival during pregnancy [23]. Giving coffee skins up to 10% in sheep feed does not have a negative impact on livestock (26). Explained that coffee skins given to sheep aged 30-60 days did not have an adverse effect on pregnancy, birth and had no effect on birth weight [27]. Excess or deficiency of nutrition affects livestock reproductive health [29]. In addition, the addition of 20% coffee skins to the concentrate did not significantly reduce the milk production of dairy cows [35]. Coffee skin contains antioxidant compounds [39,40]. The presence of antioxidant compounds in coffee skin can prevent excessive stress that causes reproductive failure.

According to [20] stress can cause failures in the reproductive process, such as damage to lipids, proteins and DNA, infertility and miscarriage. Reactive oxygen species (ROS) and antioxidants have been implicated in the regulation of reproductive processes in animals such as cyclic luteal and endometrial changes, follicular development, ovulation, fertilization, embryogenesis, embryo implantation, and placental differentiation and growth. Conversely, an imbalance between ROS production and the antioxidant system induces oxidative stress that negatively impacts the reproductive process. Coffee skin enhancer does not affect its productive parameters but reduces oxidative stress [41].

3.2.4 Litter Size

The results of statistical analysis of litter size variables showed a noticeable influence ($P<0.05$) between T_0, T_1, T_2 and T_3. However, the T_1 treatment gave the best results of 11 tails and was not significantly different from T_2 and T_0 at 10 tails and 8 tails respectively and significantly different from T_3 at 3.67 tails. This is due to the feed given, the intervals of use of males for mating and the difference in birth weight.

Fermented coffee skin contains good nutrients, namely protein, energy, phosphorus, and calcium which are able to maintain reproductive health both primary, secondary, and tertiary. Substitution of fermented coffee skins for sows is capable of producing egg cells (ovum), the hormones estrogen, progesterone, and being able to maintain pregnancy until the birth of piglets. This is reinforced by [42] which states that the difference in the number of piglets per birth between sows is caused by differences in the condition of the sow, the males used, the quality and quantity of feed consumed by sows. The number of litter sizes reached 11.6 heads/birth, litter size 8.50±1.39 heads, litter size 10.00±1.50 heads [43, 28, 44]. The number of litter size at birth is 6-12 heads [30], and 10,8 ± 0,98 heads [32] and [45] first births for sows produce 9.44 offspring, litter size 4-11 heads (46). States that the litter size of each birth for the first birth averages 9 heads, and is influenced by parental factors and 35% is influenced by other factors [47]. Litter size is influenced by the age of the mother, the breed of the mother, the mother's milk production, the condition of the mother, feed, and the males used, and with good feeding there is a tendency for litter size to increase [30]. The difference in litter size was influenced by the time the males used for mating [48]. The difference in litter size is thought to be due to the environment especially rearing management [44]. The number of piglets born is influenced by factors such as breed, age of the sow and number of litters [49]. Providing food with high nutritional content at the beginning of pregnancy can reduce embryo mortality, meet the needs of the mother and prospective piglets to be born [36].

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Figure 1. Litter Size

3.2.5 Birth Weight

Based on the results of statistical analysis, the birth weight variable was not significantly different ($P>0.05$) between T_0, T_1, T_2 and T_3. However, the T_1 treatment gave the highest birth weight of 1.65 kg compared to T_3, T_2 and T_0 with birth weights of 1.51 kg, 1.34 kg and 1.32 kg respectively. The fermented coffee skin substitution treatment did not have a significant effect on birth weight because it was caused by the number of piglets born. This is reinforced by [30] birth weight is influenced by several factors such as genetics, feed, the number of piglets in the womb, the sex of the piglets and the number of times the sow gives birth. [50] Birth weight of piglets 1.68 kg, 1.99 kg and 1.22 kg [14.51] birth weight 1.37 ± 0.23 kg [44]. The birth weight of local pigs was 0.74 ± 0,08 kg [42], the birth weights of local pigs were 0.75 kg, crossbreed pigs were 0.99 kg and purebred pigs were 1.39 kg [52]. The birth weight of piglets depends on genetic traits and feed management [53]. It was further said that the ability of the fetus to digest nutrients greatly determines the number of piglets at birth which can reduce the birth weight and weaning weight of landrace pigs [50]. Birth weight is influenced by the feed given and genetic differences between local pigs and crosses and purebred pigs [42]. It was found that coffee skin waste that can be used as feed for poultry, pigs and cattle is no more than 10-30% with the types of materials available [54]. Substitution of 0%, 5%, 10%, 15% with coffee skins that were sun-dried, soaked, boiled had no significant effect on body length, body height and chest circumference, and boiled coffee skins at a level of 5% replaced some of the feeding complete gives the best performance in body length gain and body height gain in pigs [55]. Feeding coffee husks through 25 days of gestation had no effect on birth weight [27].

3.2.6 Weaning weight

The results of the statistical analysis of the weaning weight variable showed a significant difference ($P<0.05$). However, T_1 showed the highest yield of 8.05 kg which was significantly different between T_3, T_2 and T_0 with weaning weights of 6.2 kg, 5.46 kg and 5.44 kg respectively. This is due to the feed, the condition of the piglets, the number of piglets. High nutritional feed can help the sows to produce a lot of milk, piglets that are healthy or not disabled will be able to compete with other piglets for milk, and also the number of piglets born less will get more milk and will affect weaning weight and on the contrary. This is reinforced by [51] which states that differences in weaning weight are influenced by the breed of pigs, number of piglets born, birth weight and growth of piglets after birth. Explained that differences in weaning weight were influenced by rearing management, milk production and the ability of piglets to utilize the availability of this milk [44]. Explained that high birth weight will result in high weaning weight [56] and growth after birth is strongly influenced by milk production [57]. The weaning weight of piglets can be affected by several factors, including the health of the piglets, milk production and feeding methods [58].

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Weaning weight of landrace pigs aged two months, first parity 6.42 ± 0.49 kg [44] and second parity 6.72 ± 0,51 kg, average weaning weight at first birth 7.66 kg [45], the average weaning of piglets aged 28 days was 7.14 kg [14], the average weaning weight of duroc piglets was 6.52 ± 0.98 kg), and Yorkshire pigs were 6,69 ± 0.67 kg [51]. The piglets that were weaned at the age of 21 years with birth weights below 1000 grams would have a weaning weight of 6.57 ± 0.4 kg, piglets with a birth weight of 1001 – 1200 grams would have a weaning weight of 6.84 ± 0.42 kg, and weaning piglets weighing 1201 – 1500 g will get a weaning weight of 7.02 ± 0.44 kg [56]. The piglets with a birth weight of 1.91 kg achieved a weaning weight of 9.99 kg, piglets with a birth weight of 0.97 would achieve a weaning weight of 6.45 kg [59].

The use of coffee skin flour as a partial substitute for fine bran in grower to finisher pigs can provide good growth and good efficiency of use [60]. Coffee skin fermentation with the addition of 15% Aspergillus niger to chicken rations increased body weight and feed efficiency and was significantly the same as the control ration without coffee skin [61]. Coffee skins that have been fermented are given to pigs or not fermented at a rate of 20% for 8 weeks, the results obtained are the same as those obtained in the chicken experiment. The coffee skin can be used as animal feed for poultry, pigs and cattle at levels of 10-30% [54]. Application of coffee skin fermented with tempeh yeast had a significant effect on slaughter weight and carcass percentage, and had a very significant effect on carcass weight, but had no significant effect on digesta rate and pH of broilers [62]. 15% ammoniated coffee skin waste was given to chickens for 42 days, giving broiler weight gain [63]. The use of 50% dried coffee skin had the best effect on the digestibility of broiler dry matter, and the use of 25% coffee skin had the best effect on the value of metabolic energy [64]. Coffee skin fermented with tempeh yeast in broiler rations had an effect on ration consumption, body weight gain and ration conversion, but had no significant effect on liver weight percentage, small intestine length and weight percentage [65]. Giving coffee skins 0%, 5%, 10%, and 15% does not adversely affect milk production [66]. Substitution of rice bran with Aspergillus niger fermented coffee fruit skin can increase dry matter consumption but has the same effect on weight gain, dry matter digestibility and ration conversion in goats [67]. The use of fermented coffee skins had no significant effect on ration consumption, significantly different from weight gain and feed conversion, and fermented coffee skins could be given up to 10% [68].

The addition of 20% coffee skin in the concentrate without significantly reducing dairy production, milk composition and grass dry matter intake, and reducing costs by 20% with the inclusion of coffee skin [35]. Giving coffee skin flour to sheep did not significantly affect the consumption of dry matter and crude protein and the growth of body weight, chest circumference and shoulder height, but did affect the consumption of crude fiber, crude fat and TDN and body length. So that the provision of coffee skin flour rations did not provide significant results on livestock performance, but the administration of coffee skin flour as much as 5% resulted in the highest Income Over Feed Cost (IOFC) and better feed efficiency [69]. Explained that there was no difference in feed intake and body weight gain when adding 15.23% coffee husks to the sheep feed [70]. Also found that coffee skin at a concentration of 10% in feed had no effect on sheep feed consumption [71]. In bulls fed a forage:concentrate ratio of 60:40, it was found that 40% of the coffee skin in the concentrate reduced body weight, while 30% of the coffee skin in the concentrate did not affect weight gain or feed consumption [72]. Differences in coffee skin levels given to livestock do not affect nutrient digestibility [41].

3.2.7 Mortality

Based on the results of statistical analysis the mortality variable had no significant effect ($P>0.05$) on T_0, T_1, T_2 and T_3. However, T_1 gave the best results with 0% mortality and was not significantly different from T_2, T_3 and T_0 of 0.33%, 1.33% and 1.67%, respectively. Factors that influence piglet mortality are sow stress before giving birth or during pregnancy, and the piglet's inability to deal with the environment that causes death. This is the same as [43] in broodstock the main causes of fetal death are early weaning, inadequate feed consumption

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during lactation, stress especially due to heat during the first 3 weeks of pregnancy can cause death (mummification and pre-weaning), and also nutritional imbalances that meet fetal needs. The embryonic death can be caused by an imbalance in the number of ova released from the ovary with ovum that can be fertilized [53]. Early embryonic death and environmental imbalance in the mother's womb can lead to reduced number of piglets being born. The average mortality of piglets in the results of the study [14] was 5.26%, mortality 6.3% [50], mortality 8.33-10% [73], and mortality 33.6% [43] and mortality 39.71% [28]. The dead piglets were caused by inadequate housing between the sows and the piglets [74]. In addition, it is also caused by diseases such as colds, so that the piglets become weak and have difficulty consuming milk from the sows, and death occurs [73]. The high mortality rate of piglets is caused by stress, experiencing illnesses such as lethargy, body shaking and diarrhea [75]. [76] Stated that more than 60% of piglet deaths before weaning were caused by sow factors and the influence of feeding which resulted in low milk production in the sows. The high mortality rate is influenced by traditional maintenance management [28]. Over-or undernourished pigs have adverse metabolic and reproductive health consequences that increase perinatal mortality [29]. Embryo mortality is affected by energy or protein intake during lactation [77]. Fermented coffee skin substitute has good nutrition so it does not have a negative effect on plantations which causes high embryo mortality and parturition mortality. This statement is supported by [27] giving coffee skins to sheep feed during pregnancy does not cause loss of embryos or fetuses, and they are able to give birth normally. Sheep supplemented with coffee husk waste did not affect their productive parameters but reduced oxidative stress [41].

4. Conclusion

Based on the results of the study it can be concluded that: 1) Fermented coffee skin substitution treatment increased the reproduction of sows and had a significant effect on estrus, estrus cycle, birth weight and mortality, but had a significant effect on gestation length, litter size, weaning weight of piglets. 2) Fermented coffee skin substitution treatment at 5% level gave the best results on estrous variables, estrus cycle, litter size, birth weight, weaning weight and mortality.

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