Conference Paper

Sexual Behavior and Semen Production of Kacang Buck Fed with Kelor (Moringa Oleifera Lamm) Leaf Powder as Feed Concentrate Substitution

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Abstract.
This research aimed to evaluate the effect of Kelor (*Moringa oleifera Lamm*) leaf powder substitution as feed concentrate on the sexual behaviors and semen production of Kacang bucks. This research was conducted in a randomized factorial design with 2 factors, which were Kelor leaf powder substitution levels (0; 10; 20 and 30% in concentrate) and feeding periods (0; 60; 70; 80 and 90 days) with 4 replications for each combination of treatment. All data were analysed with variance analysis and followed by Duncan's multiple range test to determine significant differences. The results showed that substitution level of Kelor leaf powder had a highly significant effect ($P<0.01$) to reaction time (libido), false mounting, and ejaculation time. Furthermore, a significant effect ($P<0.05$) was also shown to influence the erection quality but had a non-significant effect ($P>0.05$) on clamping and thrusting force, as well as semen production. The feeding periods had a highly significant effect ($P<0.01$) to reaction time (libido), ejaculation time, clamping force, erection quality, semen production and also showed a significant effect ($P<0.05$) on false mounting and thrusting force. The interaction of treatments in this research showed a highly significant effect ($P<0.01$) on ejaculation time, and a significant effect ($P<0.05$) to clamping and thrusting force, as well as erection quality but did not affect ($P>0.05$) the reaction time (libido), false mounting and semen. It can be concluded that 20% Kelor leaf powders substitution level on feed concentrate could improve the sexual behavior and semen productions of Kacang bucks.

Keywords: sexual behavior, semen production, kacang buck, kelor, feed concentrates substitution.

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1. Introduction

Kacang (*Capra hircus*) is one of the indigenous goat breed in Indonesia. This goat is highly adaptable and well spread across the country. Further development of Kacang goat rearing showed the potential to help fulfill local demand for meat products, especially considering to its good reproductive performance and survivability with simple rearing and feeding practices. Kacang goats have relatively low body weight, adaptable to tropical climatic environments, and are widespread throughout Indonesia [1][2]. In Indonesia, the breed is generally reared by smallholder farms with both intensive or extensive rearing management. Livestock productivity is generally determined by various factors, which include feed intake, rearing management, and genetics. The optimal combination of these factors positively impacts to the performance and productivity of goats [3], with feeding plays an important role and has the major economic impact to the farmer. Research [4] showed that feeding cost could cover up to 80% of the total production cost in goat rearing.

Feeding management is a critical factor that determines the reproductive performance of the goat. Feed intake has a direct effect to the goat reproduction, as it provide the nutrients required for spermatozoa and oocytes development, ovulation, fertilization, embryo development, as well as indirect effects to the hormones synthesis and regulation related to the reproduction [5][6]. The given feed should contain several nutrients that are essential for the goat reproduction, such as protein, fat, minerals, and also vitamins (especially Zn and vitamin E as antioxidants) [7][8].

The utilization of plant leaves, such as Kelor (*Moringa oleifera Lamm*) as animal feed has been widely observed and known to be effective as nutrients provider for livestock productivity. Kelor leaf has been widely fed to ruminants due to its high nutritional value [9][10]. In previous research, Kelor leaves supplementation in feed showed to be able to increase spermatozoa motility in Red Sokoto bucks [11]. Kelor leaves contained several bioactive compounds, phytosterols, and antioxidants [12] as well as Zn, which stimulates Leidig cells to produce testosterone [13], thus stimulates libido and affect sexual behavior.

In this research, the effect of Kelor leaf powder substitution on feed concentrate to the sexual behavior and semen production of Kacang bucks was investigated. The observed sexual behavior include reaction time (libido), ejaculation time, false mounting occurences, sexual aggressiveness and semen production, which are mainly used parameters for bucks selection and known to be related to environmental conditions, feed and hormone regulation [14]. The results of this research are expected to provide information for development of the Kacang goat farming in Indonesia, as well as expand the knowledge of Kelor leaf utilization as local source to improve livestock reproductive performances.

2. Materials and Methods

2.1. Materials

The materials used in this research were 16 Kacang bucks aged at 12 to 18 months, with the average body weight of 15.90 ± 1.72 kg. The Kacang bucks were placed in 16 individual cages equipped with food and drinking containers. The given feed includes elephant grass (*Pennisetum purpureum*) and concentrate feed made of rice bran, pollard, copra meal, Kelor leaf powder, and salt. For the research treatments, the composition in the feed concentrates were substituted with Kelor leaf powder at 0% (K0); 10% (K1); 20% (K2); and 30% (K3) substitution levels. The feed was given separately between elephant grass and feed concentrates, with a total of 2.5% and 1% of buck's live weight respectively. The feed was given twice daily, the first feeding was feed concentrate at 06.00 A.M and the second was elephant grass at 13.00 P.M, while the drinking water was given ad-libitum. The feed composition and treatment of the research shown in Table 1 and the results of the proximate analysis including dry matter (DM), organic matter (OM), crude fiber (CF), crude protein (CP) and ether extract (EE) for each treatment are presented in Table 2.

The equipment used in semen collection includes artificial vagina, collection tube, storage tube, protector jacket, corn, black cloth cover, thermometer, and clamp enclosure with materials used including does as a teaser, ky jelly, warm water, and tissue. The equipment used in semen quality observation includes microscope, Osse, glass cover, glass object, socorex pipette, litmus paper, hemocytometer.

2.2. Methods

The research was conducted in a completely randomized factorial design with 2 factors and 4 replications for each combination treatment, respectively. The first factor was Kelor leaf substitution level on the feed concentrates (K0 = 0%; K1 = 10%; K2 = 20%; K3 = 30%), and the second factor was feeding period (W0 = 0 days; W60 = 60 days; W70 = 70 days; W80 = 80 days; and W90 = 90 days). Moreover, the research was conducted in

Table 1: Feed composition

Feed composition	Treatment			
	K0	K1	K2	K3
Elephant grass	2.5% of body weight (% Dry Matter)			
Feed concentrates	1% of body weight (% Dry Matter)			
Feed concentrates composition:				
Rice bran (%)	35	60	58	70
Pollard (%)	29	15	17	0
Copra meal (%)	36	15	5	0
Kelor leaf powder (%)	0	10	20	30
Total (%)	100	100	100	100

Table 2: The proximate analysis of the feed treatment experiment [1]

Feed Treatment	DM (%)	OM (%)	CP (%)	CF (%)	EE (%)
Elephant grass	23.20	83.53	10.67	27.84	1.97
Concentrate: K0	91.30	92.81	16.53	17.60	12.58
K1	90.40	93.13	17.15	13.65	9.21
K2	89.77	92.82	18.32	10.71	8.29
K3	88.58	92.57	18.19	11.80	4.34

Description: Proximate analysis was obtained from Laboratory of Animal Feed and Nutrition, Faculty of Animal Science, Universitas Brawijaya Malang (October 2019). The DM, OM, CF, CP, and EE based on 100% dry matter.

3 stages including the adaptation stage, the preliminary stage, and the data collection stage.

The adaptation stage was carried out for 7 days to eliminate effect from the previous feed. At this stage, the bucks were placed in individual cages and starting fed with elephant grass and feed concentrates. In the adaptation stage, health checks were carried out and given a de-worming shot to eliminate worm parasites. The preliminary stage was done for 7 days after adaptation stage. The preliminary stage was carried out to accustomed the bucks with treated feed. At the end of the preliminary stage, the goat was weighed to determine the initial body weight. The data was collected for 90 days to determine the effect research treatments on sexual behavior and semen production. Semen collection was carried out twice a week by using an artificial vagina. The semen was collected at 07.00 to 09.00 AM.

2.2.1. Sexual behaviors observation

The sexual behaviors data was determined by following [14] [15][16], and the observed sexual behavior parameters include:

1. Libido/reaction time, which is the time needed by the bucks from getting closer to the teaser until mounting the teaser.
2. The number of false mounting is the number of times a buck performed false mounting until ejaculation.
3. The ejaculation time is the time measured from the time Kacang bucks getting closer to teaser does until ejaculation.
4. Clamping force is the male's ability to emphasize his two front legs on the semi-membraneous muscles of the teaser does during ejaculation. The clamping force is scored as strong (+++) if the Kacang bucks' forelegs were clamped right on the lumbar lateral of the teaser female goat; moderate (++) if the forelegs clamping was less stable, and weak (+) if the Kacang buck's legs were unstable or not clamped.
5. Thrusting force is the buck's ability to push his body against the teaser does during ejaculation. The thrusting force was scored as strong (+++) if the hind legs of were jumping; moderate (++) if there was a change in the hind legs position but were not jumping, and weak (+) if the hind legs position did not change and were not jumping.
6. Erection quality is the appearance of male genital organs during erection. The erection quality was scored as good (+++) if the penis color was red with or without seminal plasma fluid; moderate (++) if the penis color was pink to light pink; and bad (+) if the penis did not come out of the prepuce.

2.2.2. Semen quality observation

The semen collected from each goat was immediately tested in the laboratory to determine the semen quality. The semen production was observed by calculating the total spermatozoa and total motile spermatozoa per ejaculation and determined by following [16][17][18], with the observed variables include:

1. Total spermatozoa = volume × semen concentration.
2. Total motile spermatozoa = volume × semen concentration × individual motility.

3. Data Analysis

The obtained data were analyzed with analysis of variance and followed with Duncan's multiple range test (DMRT) to determine significant differences. Significant differences among treatments were set at $P<0.01$ (highly significant) and $P<0.05$ (significant) [19].

4. Results and Discussions

4.1. The effect of substitution levels to sexual behavior and semen production

The effect of Kelor leaf powder substitution at different levels on feed concentrates to the sexual behavior and semen production of Kacang bucks are presented in Table 3 and 4. Based on Table 3, it can be seen that the substitution levels for Kelor leaf powder showed a highly significant effect ($P<0.01$), including libido, false mounting occurrences, and ejaculation time. In addition, the Kelor leaf powder substitution level showed a significantly different effect ($P<0.05$) to erection quality but no significant effect ($P>0.05$) to the clamping and thrusting force. The higher substitution levels of Kelor leaf powder showed a positive correlation to libido of Kacang bucks due to shorter reaction (libido) and ejaculation time. The sexual behavior of Kacang goat in this research also got better, indicated by lower occurences of false mounting and better erection quality. The result was linear with [20] that showed Kelor leaf supplementation could increase the libido of Bali bulls. The clamping and thrusting force also showed a positive trend along with Kelor leaf powder substitution level up to 20%, but decreased at 30%. This condition was due to the insufficient energy and protein intake for body growth and sexual activity. Research showed that high energy and protein intake interfere with livestock aggressiveness and reduce its sexual activity [21][22].

In Table 4, it is shown that the substitution levels for Kelor leaf powder had no significant effect ($P>0.05$) to total spermatozoa and total motile spermatozoa. However, it can be seen a tendency that the higher the substitution level of Kelor leaf powder in the concentrate, the total spermatozoa, and total motile spermatozoa were also increased at the substitution levels up to 20%. Kelor leaf powder contains proteins, minerals, flavonoids, antioxidant compounds, and phytosterols [9][23] which are very useful in the process of spermatogenesis and androgen hormone synthesis [24.]

Table 3: The effect of Kelor leaf powder substitution to the sexual behavior of Kacang goat

Sexual behavior	Kelor leaf powder substitution levels			
	K0	K1	K2	K3
Reaction time (second)	15.75±5.38^{a}	10.30±5.31^{ab}	9.85±7.92^{ab}	7.55±5.35^{b}
False mounting	4.15±0.14^{a}	3.40±0.52^{b}	3.15±0.45^{b}	3.05±0.54^{b}
Ejaculation time (second)	74.90±68.54^{a}	46.00±24.75^{b}	28.50±15.69^{c}	39.15±14.78^{bc}
Clamping force	2.45±0.33^{a}	2.45±0.62^{a}	2.70±0.11^{a}	2.40±0.55^{a}
Thrusting force	2.20±0.21^{a}	2.55±0.54^{a}	2.65±0.29^{a}	2.45±0.60^{a}
Erection quality	2.65±0.29^{a}	2.35±0.68^{b}	2.75±0.35^{a}	2.60±0.58^{ab}

Description: ^{a,b,c}Different superscripts in same row indicate significant difference (P<0.05) for erection quality; a highly significant difference (P<0.01) for reaction time, false mounting, and ejaculation time

Table 4: The effect of Kelor leaf powder substitution to the semen production

Semen Production	Kelor leaf powder substitution levels			
	K0	K1	K2	K3
Total Spermatozoa (10^6)	2471.45±396.02	2553.5±796.40	3208.55±959.95	2958.05±911.07
Total motile Spermatozoa (10^6)	2082.40±361.70	2154.85±669.80	2808.06±838.29	2614.17±827.94

4.2. The effect of feeding time to the sexual behavior and semen production

The effect of Kelor leaf substitution on feed concentrates under different feeding periods to the sexual behavior and semen production of Kacang bucks are presented in Table 5 and 6. Based on Table 5, it is shown that feeding periods gave a highly significant effect (P <0.01) to the sexual behavior of Kacang bucks, which includes reaction and ejaculation time (Figure 1), clamping force, and erection quality (Figure 2). Furthermore, feeding periods also had significant effects (P<0.05) to the false mounting occurrences (Figure 3) and thrusting force (Figure 2). Moreover, sexual behavior of Kacang bucks were improved, indicated with lower false mounting occurrences, better clamping force, thrusting force, and erection quality. This result was linear with [14] on Boer goats, with longer feeding periods of Kelor leaf powder increased the clamping and thrusting force until reached 70th day.

The increased clamping and thrusting force were due to the energy and protein availability that directly affect sexual activities of the livestock. Research [20][25] showed that sufficient energy and protein intakes contribute to the livestock aggressiveness and sexual activities.

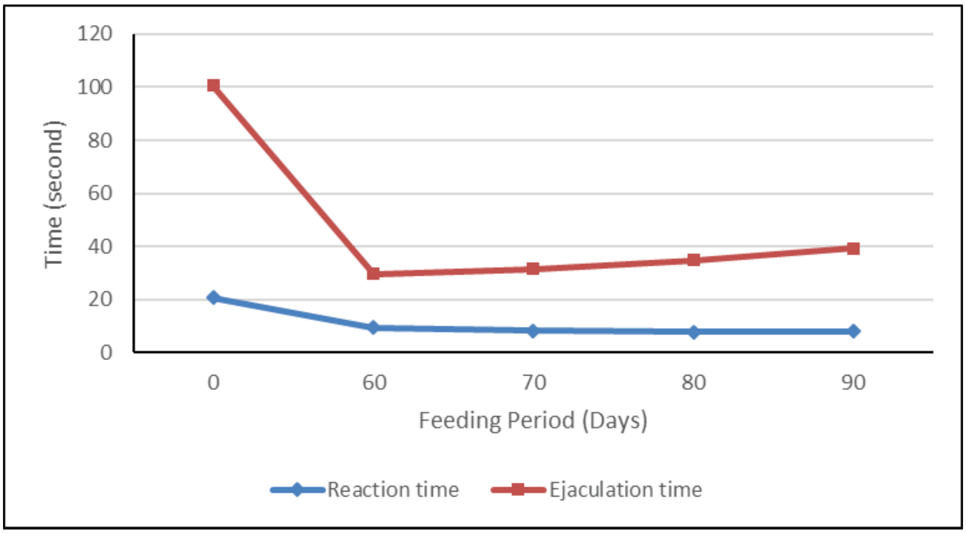

Figure 1: Kelor leaves powder feeding period to reaction and ejaculation time of Kacang bucks.

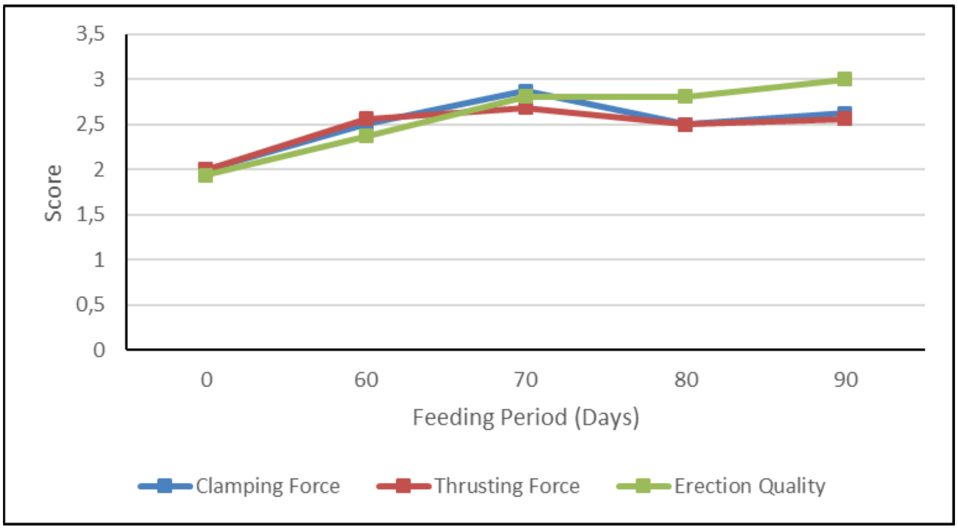

Figure 2: Kelor leaf powder feeding period to sexual behaviors of Kacang bucks.

Based on Table 6, it can be seen that longer feeding periods increased total spermatozoa and total motile spermatozoa with a highly significant difference ($P<0.01$). This result was caused by bioactive nutrient availability in Kelor leaf powders. Kelor leaf powder contained the nutritional content and bioactive compounds [12] that support the growth process of testicle and spermatozoa cells production [26]. The protein in Kelor leaf powders stimulates the synthesis of gonadotropin-releasing hormone (GnRH), which stimulates the production of follicle stimulating hormone (FSH) and luteinizing hormone (LH), which in turn affect the synthesis of the testosterone hormone. The testosterone hormone plays an important role in spermatogenesis [6][20][27].

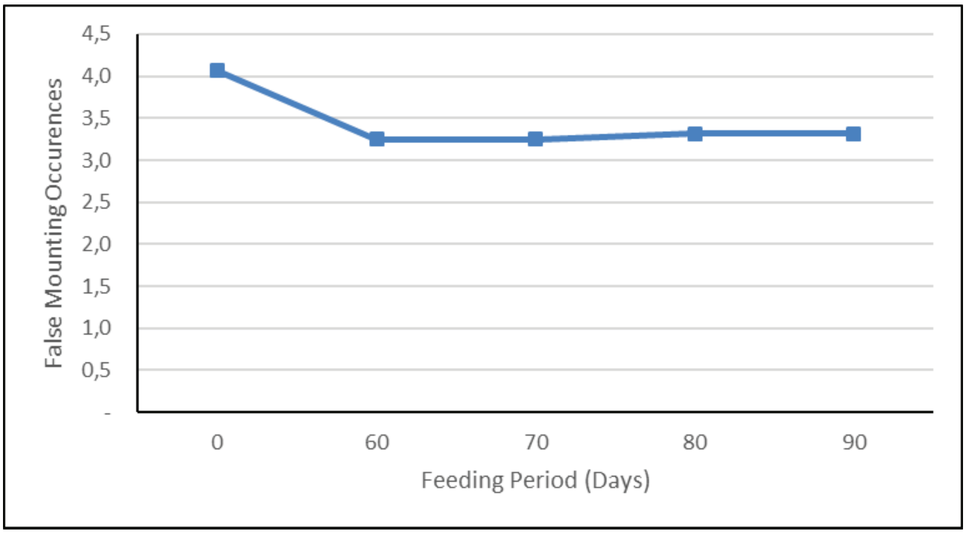

Figure 3: Kelor leaf powder feeding period to false occurrences of Kacang bucks.

TABLE 5: The effect of feeding period of Kelor leaf powder to the sexual behavior of Kacang bucks

Sexual Behavior	Feeding periods				
	W0	W60	W70	W80	W90
Reaction time (second)	20.69±3.44^{a}	9.56±3.11^{b}	8.31±1.89^{b}	7.75±4.11^{b}	8.00±7.27^{b}
False mounting	4.06±0.24^{a}	3.25±0.54^{b}	3.25±0.74^{b}	3.31±0.55^{b}	3.31±0.66^{b}
Ejaculation time (second)	100.50±65.50^{a}	29.63±13.62^{b}	31.45±10.82^{b}	34.75±5.55^{b}	39.38±15.15^{b}
Clamping force	2.00±0.61^{b}	2.50±0.20^{a}	2.88±0.14^{a}	2.50±0.29^{a}	2.63±0.32^{a}
Thrusting force	2.00±0.54^{b}	2.56±0.24^{a}	2.69±0.38^{a}	2.50±0.46^{a}	2.56±0.38^{a}
Erection quality	1.94±0.55^{c}	2.38±0.25^{b}	2.81±0.24^{a}	2.81±0.24^{a}	3.00±0.00^{a}

Description: ^{a,b,c}Different superscripts in same row indicate significant difference (P<0.05) for false mounting and thrusting force; a highly significant difference (P<0.01) for reaction time, ejaculation time, clamping force, erection quality, and semen production

TABLE 6: The average performance of semen production in various periods of substitution of Kelor leaf powder in the concentrate.

Semen production	Feeding periods				
	W0	W60	W70	W80	W90
Total Spermatozoa (10^{6})	1658.56 ± 318.93^{b}	2724.44 ± 312.06^{a}	2950.50 ± 478.13^{a}	3279.50 ± 864.82^{a}	3376.44 ± 539.41^{a}
Total motile Spermatozoa (10^{6})	1385.20 ± 231.76^{b}	2370.35 ± 281.73^{a}	2603.56 ± 503.93^{a}	2823.12 ± 766.31^{a}	2892.10 ± 529.57^{a}

Description: ^{a,b}Different superscripts in same row indicate a highly significant difference (P<0.01)

4.3. The interaction effect of substitution levels and feeding periods to the sexual behavior and semen production

The results of interaction of substitution levels and feeding periods of Kelor leaf to the sexual behavior and semen production are presented in Table 7 and 8.

TABLE 7: The average performance of sexual behavior in each treatment combination.

Sexual behaviors	Substitution levels	Feeding periods				
		W0	W60	W70	W80	W90
Reaction time (second)	K0	23.75 ± 7.76^a	12.00 ± 6.16^a	11.00 ± 5.60^a	13.25 ± 7.72^a	18.75 ± 7.14^a
	K1	19.25 ± 4.57^a	10.75 ± 3.95^a	7.00 ± 4.24^a	8.50 ± 2.89^a	6.00 ± 3.16^a
	K2	23.25 ± 7.80^a	10.5 ± 2.08^a	7.00 ± 2.94^a	4.25 ± 1.26^a	4.25 ± 1.26^a
	K3	16.50 ± 5.97^a	5.00 ± 3.56^a	8.25 ± 2.36^a	5.00 ± 2.16^a	3.00 ± 1.41^a
False mounting	K0	4.25 ± 1.50^a	4.00 ± 1.15^a	4.25 ± 1.50^a	4.00 ± 1.15^a	4.25 ± 1.50^a
	K1	4.25 ± 0.50^a	3.00 ± 0.82^a	3.25 ± 0.50^a	3.50 ± 0.58^a	3.00 ± 0.82^a
	K2	3.75 ± 0.50^a	3.25 ± 0.50^a	2.50 ± 0.58^a	3.00 ± 0.00^a	3.25 ± 0.50^a
	K3	4.00 ± 0.82^a	2.75 ± 0.50^a	3.00 ± 0.82^a	2.75 ± 0.50^a	2.75 ± 0.50^a
Ejaculation time (second)	K0	196.00 ± 93.85^a	47.25 ± 24.02^{bcd}	32.25 ± 12.20^{bcd}	38.25 ± 15.22^{bcd}	60.75 ± 13.87^b
	K1	90.25 ± 30.28^b	33.50 ± 14.01^{bcd}	35.75 ± 17.29^{bcd}	35.25 ± 14.52^{bcd}	35.25 ± 12.31^{bcd}
	K2	55.50 ± 32.55^{bcd}	19.00 ± 4.97^d	16.25 ± 9.60^d	26.75 ± 12.09^d	25.00 ± 9.70^{cd}
	K3	60.25 ± 28.02^b	18.75 ± 5.56^d	41.50 ± 12.90^{bcd}	38.75 ± 19.62^{bcd}	36.50 ± 8.81^{bcd}
Clamping force	K0	2.25 ± 0.50^{ab}	2.50 ± 0.58^a	3.00 ± 0.00^a	2.25 ± 0.50^{ab}	2.25 ± 0.96^{ab}
	K1	1.50 ± 0.58^b	2.50 ± 0.58^a	3.00 ± 0.00^a	2.25 ± 0.50^{ab}	3.00 ± 0.00^a
	K2	2.75 ± 0.50^a	2.75 ± 0.50^a	2.75 ± 0.50^a	2.75 ± 0.50^a	2.50 ± 0.58^a
	K3	1.50 ± 0.58^b	2.25 ± 0.50^{ab}	2.75 ± 0.50^a	2.75 ± 0.50^a	2.75 ± 0.50^a
Thrusting force	K0	2.00 ± 0.82^{bcd}	2.50 ± 0.58^{ab}	2.25 ± 0.50^{abcd}	2.00 ± 0.00^{bcd}	2.25 ± 0.96^{abcd}
	K1	1.75 ± 0.96^{cd}	2.75 ± 0.50^{ab}	3.00 ± 0.00^a	2.25 ± 0.50^{abcd}	3.00 ± 0.00^a
	K2	2.75 ± 0.50^d	2.75 ± 0.50^{ab}	2.50 ± 0.58^{ab}	3.00 ± 0.00^a	2.25 ± 0.96^{abcd}
	K3	$1.50\pm0,58^{ab}$	2.25 ± 0.50^{abcd}	3.00 ± 0.00^a	2.75 ± 0.50^{ab}	2.75 ± 0.50^a
Erection quality	K0	2.25 ± 0.50^{de}	2.75 ± 0.50^a	2.75 ± 0.50^a	2.5 ± 0.58^a	3.00 ± 0.00^a
	K1	1.25 ± 0.50^f	2.25 ± 0.50^{cd}	2.5 ± 0.58^a	2.75 ± 0.50^a	3.00 ± 0.00^a
	K2	2.5 ± 0.58^a	2.25 ± 0.5^{bc}	3.00 ± 0.00^a	3.00 ± 0.00^a	3.00 ± 0.00^a
	K3	1.75 ± 0.50^{ef}	2.25 ± 0.50^{ab}	3.00 ± 0.00^a	3.00 ± 0.00^a	3.00 ± 0.00^a

Description: ^{a,b,c,d,e,f} Different superscripts in same row indicate significant difference (P<0.05) for false mounting and thrusting force; a highly significant difference (P<0.01) for ejaculation time

Based on Table 7, it is shown that the interaction of substitution levels and feeding periods of Kelor leaf powders gave a highly significant effect (P<0.01) to ejaculation time, showed a significant difference (P<0.05) to the better clamping force, thrusting force, and erection quality but no significant effect (P>0.05) to reaction time and false mounting occurrences of Kacang bucks. The higher substitution levels and longer periods application the substitution Kelor leaf powders in the concentrate gave better sexual behavior of Kacang bucks. It can be seen that the interaction of substitution levels and feeding periods gave shorter ejaculation time and better clamping force, thrusting force, as well as erection quality. The reaction time and false mounting occurrences also showed a positive correlation to the substitution levels and feeding periods interaction even though were not significant (P>0.05). A similar results were also found on [20][25] which showed that Kelor leaf powders supplementation increased sexual behavior in male animals.

Table 8: The average performance of semen production in each treatment combination

Semen production	Substitution levels	Feeding periods				
		W0	W60	W70	W80	W90
Total Spermatozoa (10^6)	K0	2067.00 ± 1057.25	2827.50 ± 1351.97	2541.00 ± 1475.50	2053.50 ± 987.90	2868.25 ± 1291.17
	K1	1289.75 ± 343.52	2301.25 ± 1128.07	2864.00 ± 1068.37	3319.50 ± 1032.78	2993.00 ± 799.89
	K2	1611.25 ± 405.94	3044.50 ± 1251.07	3638.75 ± 1294.45	3738.75 ± 1491.40	4009.50 ± 1354.09
	K3	1666.25 ± 672.65	2724.50 ± 881.15	2758.25 ± 470.91	4006.25 ± 1551.95	3635.00 ± 574.14
Total motile Spermatozoa (10^6)	K0	1634.55 ± 901.51	2443.50 ± 1201.88	2183.28 ± 1280.28	1773.60 ± 943.20	2377.06 ± 1117.00
	K1	1073.70 ± 342.16	1973.13 ± 976.77	2447.05 ± 935.44	2774.58 ± 965.84	2505.80 ± 679.94
	K2	1415.25 ± 395.53	2638.35 ± 1233.44	3336.00 ± 1247.29	3206.38 ± 1231.23	3444.30 ± 1112.98
	K3	1417.31 ± 598.39	2426.43 ± 820.38	2447.93 ± 429.23	3537.94 ± 1469.52	3241.25 ± 643.73

Based on Table 8, it is shown that the interaction between substitution levels and feeding periods of Kelor leaf powders on feed concentrates to Kacang bucks showed no significant effect (P>0.05) to the total spermatozoa and total motile spermatozoa. However, there was a trend of increased total spermatozoa and total motile spermatozoa along with higher substitution levels and longer feeding periods. A similar results were found on previous researches [20][27] that showed increased spermatozoa concentrations, libido, and spermatozoa motility due to the Kelor leaves supplementation.

5. Conclusion

Kelor leaf powder can be used as feed concentrate substitution for Kacang bucks to improve sexual behavior and semen production, with the best was shown at 20% substitution level.

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