CHARPTER 4

Results

Experiment I: Study on the effects of concentrate supplementation levels on growth performance of local female goats in Laos

4.1 Chemical composition of feed

The chemical composition of CONc and PML is shown in table 4.1. The dry matter (% As fed) of paper mulberry leaves and concentrate were 26.5 and 88.8, respectively. Ash, organic matter, crude protein, crude fiber, ether extract, nitrogen free extract, neutral detergent fiber, acid detergent fiber, acid detergent lignin of paper mulberry leaves and concentrate were 15.2 and 5.8, 78.1 and 83.7, 19.0 and 15.4, 14.5 and 7.3, 3.5 and 11.7, 47.7 and 59.9, 41.4 and 23.5, 22.3 and 9.6, 2.8 and 2.1, respectively.

Table 4.1 Chemical compositions of the diets (PML and CONc) on DM basis

Item (%)	Paper mulberry leaves (PML)	Concentrate (CONc)
Dry matter	26.5	88.8
Ash	15.2	5.8
Organic matter	78.1	83.7
Crude protein	19.0	15.4
Crude fiber	14.5	7.3
Ether extract	3.5	11.7
Nitrogen free extract	47.7	59.9
Neutral detergent fiber	41.4	23.5
Acid detergent fiber	22.3	9.6
Acid detergent lignin	2.8	2.1

PML = Paper mulberry leaves, CONc = Concentrate

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4.2 Nutrients intake and growth performance

The nutrients intake are presented in the table 4.2. The results indicated that goats fed PML and CONc supplementation levels significantly (*P<0.01*) increased OMI, CPI, EEI, CFI, NFEI, NDFI, ADFI, and ADLI compared to the control group T1 0 g/head/day) (Table 4.2). The highest value was observed in goats fed with T4 (400 g/head/day) of concentrate supplementation following by T3 (300 g/head/day) and T2 (200 g/head/day), respectively. Concentrate supplementation with 300 and 400 g/head/day had significant higher CF, ADF, and ADL compared to the control group and 200 g/head/day concentrate supplementation. There were no significant different on ADL intake between goats fed 200 g/head/day of concentrate group and control group.

Table 4.2 Total nutrient intake of local female goats in Laos

Nutrient intake g/head/day)	Level of concentrate supplementation (g/day)				SEM	*P*-Value		
	(0)T1	(200)T2	(300)T3	(400)T4		Treatment	L	Q
OM	$648^{a} \pm 61$	$778^{b} \pm 47$	$874^{c} \pm 24$	$944^{d} \pm 28$	0.021	< 0.01	< 0.01	0.09
CP	$158^{a} \pm 15$	$181^{b} \pm 12$	$200^{c} \pm 60$	$213^{d} \pm 70$	0.005	< 0.01	< 0.01	0.19
EE	$29^{a} \pm 30$	$49^{b} \pm 20$	$60^{c} \pm 10$	$70^{d} \pm 20$	0.001	< 0.01	< 0.01	< 0.01
CF	$120^{a} \pm 11$	$130^{b} \pm 9$	$141^{c} \pm 50$	$146^{c} \pm 50$	0.004	< 0.01	< 0.01	0.26
NFE	$396^{a} \pm 37$	$490^{b} \pm 28$	$557^{c} \pm 15$	$607^{d} \pm 18$	0.014	< 0.01	< 0.01	0.39
NDF	$343^{a} \pm 31$	$376^{b} \pm 25$	$409^{c} \pm 13$	$427^{c} \pm 14$	0.012	< 0.01	< 0.01	0.77
ADF	$187^{a} \pm 18$	$199^{a} \pm 14$	$221^{b} \pm 70$	$221^{b} \pm 80$	0.007	< 0.01	< 0.01	0.28
ADL	$24^{a} \pm 20$	$27^{ab} \pm 20$	$29^{b} \pm 10$	$31^{b} \pm 10$	0.002	< 0.01	< 0.01	0.06

PML = Paper mulberry leaves, CONc = Concentrate, DM = Dry matter**;** OM = Organic matter, CP = Crude protein, CF = Crude fiber, NFE = Nitrogen free extract**,** NDF = Neutral detergent fiber, ADF = Acid detergent fiber, ADL = Acid detergent lignin, L = Linear, Q = Quadratic.

^{a,b,c,d} = Values in the same row with different superscripts differ significantly at *P<0.05* level

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Percentage of DM intake per body weight was significantly (*P<0.01*) increased from T1 to T4 (3.5 to 4.6 %/BW) (Table 4.3). The growth performance of local female goats fed different levels of CONc is shown in the table 4.3. The results showed that goats fed concentrate were significantly greater body weight change and ADG than the control group (Table 4.3). The highest values of ADG were observed in goats fed 400 g/day concentrate (65.2 g/head/day) followed by 300 and 200 g/day concentrate, respectively (Table 4.3). Lower FCR were observed in goats fed concentrate diets compared with control group (*P<0.017*).

Table 4.3 Growth performance of female goats fed different levels of concentrate

Growth performance	Levels of supplementation of concentrate (g/day)				SEM	*P*-value		
	(0)T1	(200)T2	(300)T3	(400)T4		Treatment	L	Q
Initial BW (kg)	22.3 ± 2.9	21.8 ± 4.4	22.8 ± 3.1	22.9 ± 3.3	1.512	0.857	0.64	0.80
Final BW (kg)	25.6 ± 3.2	26.5 ± 4.5	28.2 ± 3.2	28.9 ± 3.7	1.665	0.185	0.09	0.96
BW change (kg)	3.2^{a} ± 0.7	4.7^{b} ± 0.6	5.4^{bc} ± 0.8	6.0^{c} ± 0.8	0.434	< 0.01	< 0.01	0.16
DMI (g/d)	830^{a} ± 78	984^{b} ± 60	$1,101^{c}$ ±31	$1,183^{d}$ ±36	0.028	< 0.01	< 0.01	0.16
DMI (% BW)	3.5^{a} ± 0.3	4.2^{b} ± 0.5	4.4^{bc} ± 0.4	4.6^{c} ± 0.5	0.189	< 0.01	< 0.01	0.13
ADG (g/day)	35.0^{a} ± 7.5	51.1^{b} ± 6.3	58.7^{bc}±9.1	65.2^{c} ±8.8	4.720	< 0.01	< 0.01	0.13
FCR	24.5^{a} ± 4.6	19.5^{b} ± 2.3	19.1^{b} ± 3.1	18.4^{b} ±2.4	1.833	< 0.017	< 0.01	0.23

BW = Body weight, DMI = Dry matter intake, ADG = Average daily gain, FCR = Feed conversion ratio, L = Linear, Q = Quadratic.

^{a,b,c,d} = Values in the same row with different superscripts differ significantly at *P<0.05* level and not significantly *P>0.05* level

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4.3 *In vivo* apparent nutrient digestibility

The *In vivo* apparent nutrient digestibility is presented in table 4.4. The results revealed that goats fed concentrate diet 200, 300, and 400 g/head/day were significantly higher in DMD, OMD, CPD, EED, and NFED compared to the control group. There were no significant different in CFD, NDFD, ADFD, and ADLD were found in goats fed level of concentrate compared to the control group. The total digestible nutrient (TDN), digestible energy (DE) metabolizable energy (ME) and net energy of lactation (NE_L) were found significant difference in statistic (Table 4.4).

Table 4.4 Nutrient digestibility of local female goats fed PML and CONc (%)

Apparent Digestibility (%)	Level of supplementation of CONc (g/head/day)				SEM	*P*-Value		
	(0)T1	(200)T2	(300)T3	(400)T4		Treatment	L	Q
DMD	83.1^{a}	84.9^{b}	87.6^{c}	87.8^{c}	0.690	< 0.01	< 0.01	0.13
OMD	86.8^{a}	87.4^{a}	89.6^{b}	89.7^{b}	0.610	< 0.01	< 0.01	0.65
CPD	87.6^{a}	88.5^{ab}	89.8^{bc}	90.2^{c}	0.670	< 0.01	< 0.01	0.60
EED	63.9^{a}	80.3^{b}	85.9^{c}	88.0^{c}	1.228	< 0.01	< 0.01	< 0.01
CFD	73.4	73.6	75.0	76.0	1.738	0.398	0.18	0.63
NFED	91.7^{a}	92.5^{ab}	93.6^{b}	93.6^{b}	0.502	< 0.01	0.79	0.04
NDFD	76.97	77.3	79.5	79.6	1.220	0.079	0.23	0.38
ADFD	75.1	73.9	75.8	76.1	1.272	0.339	0.05	0.27
ADLD	37.8	35.6	41.2	47.7	5.571	0.180	< 0.01	0.23
TDN (%)	57.36^{a}	81.28^{b}	84.65^{cd}	86.03^{d}	1.687	< 0.01	< 0.01	< 0.01
DE (Mcal/kg)	2.58^{a}	3.65^{b}	3.80^{cd}	3.86^{d}	0.075	< 0.01	< 0.01	< 0.01
ME_1 (Mcal/kg)	2.11^{a}	3.17^{b}	3.32^{cd}	3.38^{d}	0.075	< 0.01	< 0.01	< 0.01
ME_2 (MJ/kg)	8.76^{a}	12.45^{b}	12.97^{cd}	13.20^{d}	0.257	< 0.01	< 0.01	< 0.01
NE_L (Mcal/kg)	1.29^{a}	1.87^{b}	1.95^{cd}	1.99^{d}	0.041	< 0.01	< 0.01	< 0.01

PML = Paper mulberry leaves, CONc = Concentrate, DM: Dry matter**;** OM: Organic matter, CP: Crude protein, CF: Crude fiber, NFE: Nitrogen free extract**,** NDF: Neutral detergent fiber, ADF: Acid detergent fiber, ADL: Acid detergent lignin L = Linear, Q = Quadratic.

^{a,b,c,d} = Values in the same row with different superscripts differ significantly at $P<0.05$ level and not significantly $P>0.05$ level

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Experiment II: Study the on effects of concentrate supplementation levels on response to estrous synchronization of local female goats in Laos

4.4 Live weight change and growth performance

The body weight, body weight change, and growth performance of the goats during the experimental period are presented in Table 4.5. There was no difference in the initial body weights between the PML and the PML + CONc groups (*P>0.05*). Similarly, there was no difference (*P>0.05*) between the PML and the PML + CONc groups as regards to final body weights after the end of the feeding period. However, the positive changes in the live weight of the female goats in the PML + CONc group were greater than those in the PML group (*P<0.05*). The body weight of female goats did not differ significantly between the PML and the PML + CONc groups (*P>0.05*) on day 0, day 7, day 21, day 28, day 35, day 49, day 56, and day 61 of the nutritional period (Figure 4.1). On the other hand, the body weight tended to be higher (*P=0.08*) in the PML + CONc group than that in the PML group on day 42 of the nutritional period (Figure 4.1). Moreover, the ADG of the female goats receiving the PML + CONc treatment had a greater (*P<0.05*) value compared with the goats receiving the PML treatment (Table 4.5). The FCR of the goats in the PML + CONc group was lesser (*P<0.05*) than that in the PML group (Table 4.5).

4.5 Spontaneous estrus during pre-synchronization period

In the pre-synchronization period (covering two estrous cycles), there were no significant differences (*P>0.05*) between the PML and the PML + CONc groups as regards to the proportions of female goats displaying estrus in the first (58.3% vs 75.0%) and the second (66.7% vs 75.0%) estrous cycles (Figure 4.2).

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Table 4.5 Effects of supplementation PML and CONc to female goats in Laos

Item	Dietary treatment	
	PML	**PML + CONc**
Initial body weight (kg)	25.5 ± 3.1	25.3 ± 4.3
Final body weight (kg)	26.9 ± 2.7	28.5 ± 3.9
Body weight change (kg)	1.4^{a} ± 0.6	3.2^{b} ± 0.9
ADG (g/day)	24.9^{a}	53.2^{b}
Dry matter intake (g/head/day)	768.8^{a}	$1{,}090.6^{b}$
Metabolizable energy (MJ/kg DM)	8.9^{a}	13.2^{b}
FCR	34.8^{a}	22.2^{b}

ADG = average daily gain; FCR = feed conversion ratio; PML= paper mulberry leaves; PML + CONc = paper mulberry leaves + concentrate.

^{a,b}Treatments denoted with different superscript letters are different at $P<0.05$.

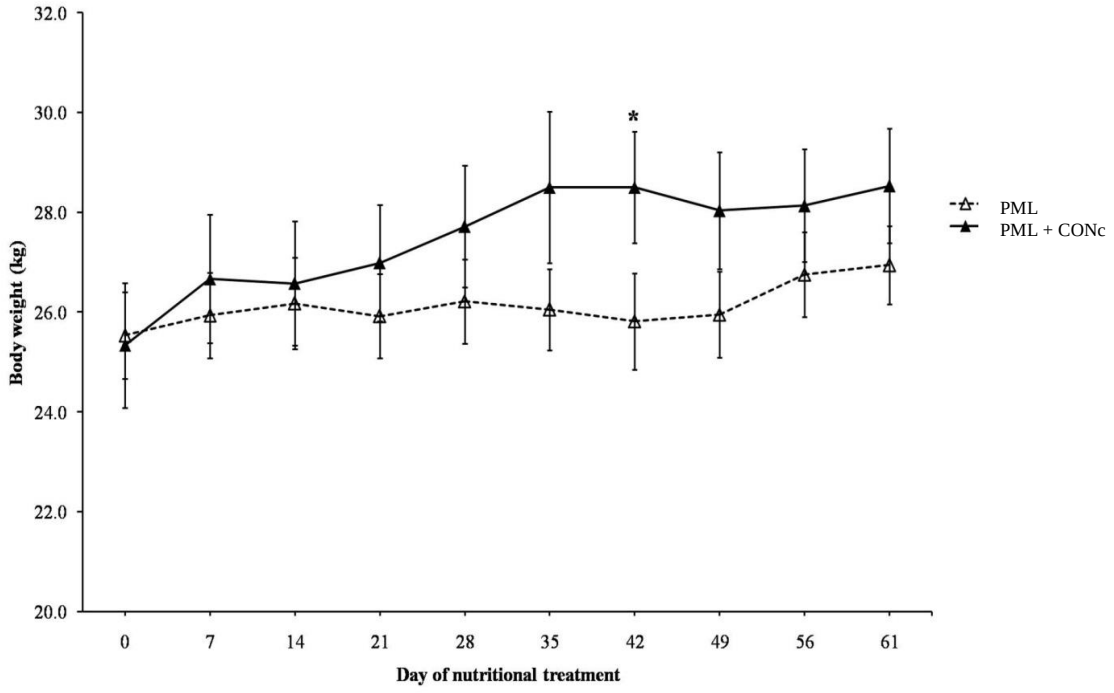

Figure 4.1 The body weight of female goats received the paper mulberry leaf-based diet (PML; dotted line) or the paper mulberry leaves and 400 g/head/day of the concentrate (PML+CONc; solid line).

*Treatment denoted with asterisk tends to be different at $P=0.08$.

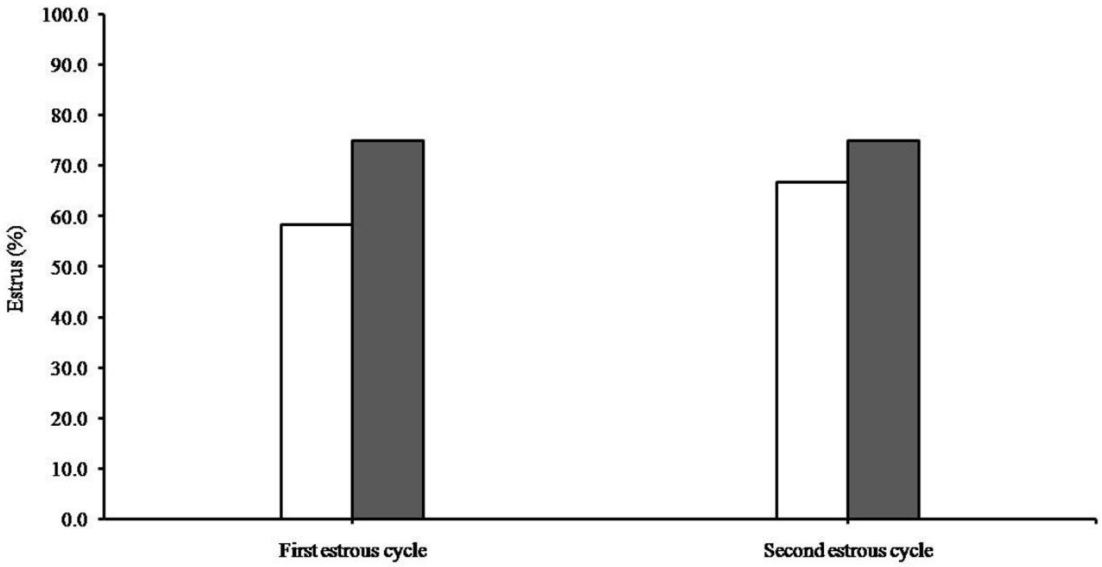

Figure 4.2 Proportion of female goats exhibiting spontaneous estrus during the pre-synchronization period (covering two estrous cycles) in the group of goats receiving the paper mulberry leaf-based diet (PML; open bars) or the paper mulberry leaves and 400 g/head/day of the concentrate (PML + CONc; solid bars).

4.6 Response to synchronization of estrus

The proportion of synchronized goats displaying estrous behavior was not significantly different (*P>0.05*) between the PML and the PML + CONc groups (Table 4.6). Nevertheless, synchronized goats that were fed only the PML diet tended to have a delay (*P=0.09*) in the interval to the onset of estrus in comparison with goats that were fed the paper mulberry leaves and 400 g/head/day of the concentrate (PML + CONc; Table 4). The durations of estrus of the synchronized goats did not differ (*P>0.05*) between the PML and the PML + CONc groups (Table 4.6). Interestingly, the proportion of synchronized goats displaying estrous behavior at 48 h after CIDR withdrawal was significantly higher (*P<0.05*) in the group that received the PML + CONc diet than in the group that received the PML diet (75.0% vs 33.3%; Figure 4.3). At 60 h and 72 h after the CIDR removal, the proportions of female goats that exhibited estrus did not differ statistically (*P>0.05*) between the PML and the PML + CONc groups (75.0% vs 91.7% and 25.0% vs 25.0% for 60 h and 72 h, respectively, after the CIDR removal; Figure 4.3).

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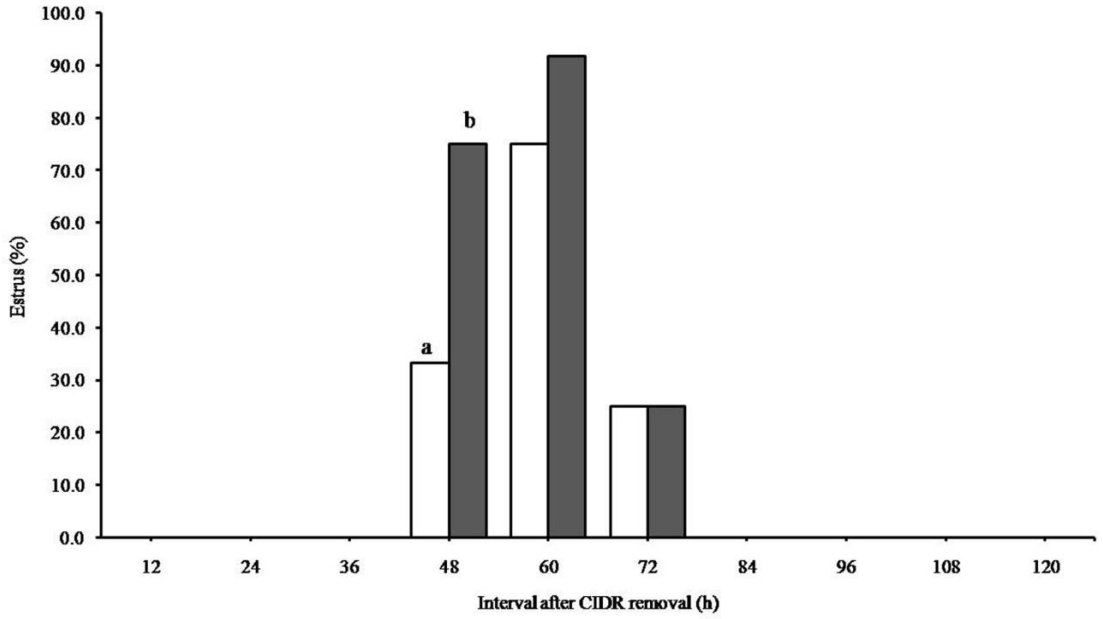

Figure 4.3 The cumulative proportion of female goats displaying estrous behavior in 12 h to 120 h after CIDR withdrawal in the group of goats receiving the paper mulberry leaf-based diet (PML; open bars) or the paper mulberry leaves and 400 g/head/day of the concentrate (PML + CONc; solid bars). CIDR, controlled intravaginal drug release devices.

4.7 Ovulation, diameter of largest preovulatory follicle, and time of ovulation

Incidences of induced ovulation in the goats were not significantly different (*P>0.05*) between the PML and the PML + CONc groups (Table 4.6). However, the female goats that received the PML + CONc diet had greater (*P<0.05*) diameters of the largest preovulatory follicle than the female goats that received the PML diet (Table 4.6). Moreover, the female goats that received only the PML diet tended to have a delay (*P=0.09*) in the interval from the CIDR removal to the ovulation in comparison with the goats that received the PML + CONc diet (Table 4.6). However, the intervals from estrus to ovulation of the synchronized goats did not differ (*P>0.05*) between the PML and the PML + CONc groups (Table 4.6).

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Table 4.6 Effects of supplementation of paper mulberry leaf-based diet with concentrate on response to estrous synchronization treatment, diameter of preovulatory follicle, and time of ovulation in synchronized local female goats in Laos.

Item	Dietary treatment	
	PML	PML + CONc
No. of female goats	12	12
Estrus (%)	9/12 (75.0)	11/12 (91.7)
Interval from CIDR removal to estrus (h)	$54.7^{x} \pm 2.1$	$50.2^{y} \pm 1.6$
Duration of estrus (h)	22.7 ± 3.7	25.1 ± 1.2
Ovulation (%)	9/12 (75.0)	11/12 (91.7)
Diameter of largest preovulatory follicle (mm)	$5.7^{a} \pm 0.1$	$6.1^{b} \pm 0.1$
Interval from CIDR removal to ovulation (h)	$88.0^{x} \pm 4.5$	$77.5^{y} \pm 4.1$
Interval from estrus to ovulation (h)	32.0 ± 2.8	30.5 ± 3.3

PML= paper mulberry leaves; PML + CONc = paper mulberry leaves + concentrate; CIDR = controlled intravaginal drug release devices.

[a, b]Treatments denoted with different superscript letters are different at *P<0.05*.

[x, y]Treatments denoted with different superscript letters tend to be different at *P=0.09*.

4.8 Reproductive performance

Overall, the fecundity, the infertility, the fertility**,** and the kidding rate, the proportion of kids varies according to gender, the kid yield, and the prolificacy were not significantly different (*P>0.05*) between the PML and the PML + CONc groups (Table 4.7). However, the average number of kids born alive per total number of female goats (the productivity) tended to be greater (*P=0.08*) in group that received the PML + CONc diet than in the group that received the PML diet (Table 4.7). In goats that received the PML + CONc, incidences of births were observed, with the majority of the goats having single and some of them having twin births. However, none of the kidding goats that received only the PML exhibited twin birth (Table 4.7).

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Table 4.7 Effect of supplementation of paper mulberry leaf-based diet with concentrate on reproductive performances in synchronized local female goats in Laos

Variable	Dietary treatment	
	PML	PML + CONc
No. of female goats	12	12
No. of female goats mating	9	11
No. of pregnant female goats	6	10
No. of female goats kidding	5	9
Fecundity (%)	66.7 (6/9)	90.9 (10/11)
Infertility (%)	33.3 (3/9)	9.1 (1/11)
Fertility (%)	55.6 (5/9)	81.8 (9/11)
Single kidding rate (%)	100.0 (5/5)	88.9 (8/9)
Twin kidding rate (%)	—	11.1 (1/9)
No. of kids born alive	5	10
No. of single kid	5	8
Female (%)	80.0 (4/5)	62.5 (5/8)
Male (%)	20.0 (1/5)	37.5 (3/8)
No. of twin kids	—	2
Female (%)	—	100.0 (2/2)
Male (%)	—	—
Productivity (no.)	$0.4^{x} \pm 0.15$	$0.8^{y} \pm 0.17$
Kid yield (no.)	0.6 ± 0.17	0.9 ± 0.17
Prolificacy (no.)	1.0 ± 0.23	1.1 ± 0.19

PML = paper mulberry leaves; PML + CONc = paper mulberry leaves + concentrate.

[x, y]Treatments denoted with different superscript letters tend to be different at *P=0.08.*

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