

Animal Review

2019 Vol. 6, No. 2, pp. 24-31

ISSN(e): 2409-6490

ISSN(p): 2412-3382

DOI: 10.18488/journal.ar.2019.62.24.31

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EFFECTS OF SEGREGATED EARLY WEANING AT 7 DAYS ON DAMS' BODY CONDITION, PARTURITION INTERVAL AND OFFSPRING BIRTH WEIGHT AND LITTER SIZE IN THE AGOUTI (*Dasyprocta Leporina*) FOR INTENSIVE PRODUCTION

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ABSTRACT

Article History

Received: 13 June 2019

Revised: 19 July 2019

Accepted: 26 August 2019

Published: 10 October 2019

Keywords

Sex ratio

Growth rate

Average daily gain

Successive parturition

Offspring

Reproduction.

There has been limited information reported on the impacts of segregated early weaning on agouti (*Dasyprocta leporina*) dams. The study lasted 485 days where 4 parturitions were recorded from 12 (2 year old) multiparous dams, hence there were 48 (12 x 4) parturitions in total with 100 offspring being born. Data was collected on 1) the live weight gain of dams (+/- g), 2) re-conception time and parturition interval (through theoretical calculations assuming that the gestation period was 104 days), 3) litter size at each parturition 4) weight of each individual offspring born per litter as a % of dams' live weight and 5) the ratio of offspring sex at each parturition. Results showed that dams can reconceive and have a successive parturition as early as 119 days after the day of her previous parturition. Average live weight gain after 4 consecutive parturitions for dams were 276g. Average offspring weights increased by approximately 23 g (193 g to 216g) after 4 parturitions when weaned at 7 days. Average litter size per dam increased by 33% (1.75 to 2.33) after 4 parturitions when weaned at 7 days. Litter size as a percentage of dam's body weight increased by 0.11% (5.47 to 5.58) after 4 parturitions when weaned at 7 days. This study concludes that weaning at 7 days post-partum is very beneficial for dams' body condition and re conception, offspring growth and development and for continuous reproduction in an intensive production unit.

Contribution/Originality: This study is one of very few studies which have investigated the impacts of segregated early weaning on agouti (*Dasyprocta leporina*). Weaning at 7 days post-partum is very beneficial for dams' body condition and re conception, offspring growth and development and for continuous reproduction in an intensive production unit.

1. INTRODUCTION

Gestation periods for the Agouti were recorded to be from as early as 97 days [1] to 104 days [2] to 105 days [3] to 104- 120 days [4-6]. The length of the oestrus cycle was 34 +/- 2.1 days with a range of 12-59 days Weir [7]. Weir [4] also stated that agouti female ovulation may be spontaneous and that postpartum estrus may exist. In an experiment with 18 agouti females, Guimarães, et al. [8] found that the estrus cycle (proestrus, estrus, metestrus and diestrus) was 32.05 +/- 4.17 days (25 to 40 days) with an estrus period of 24 hours. Singh, et al. [9] reported an oestrus cycle of 31 days (+/- 4 days) with 17 days (+/- 2 days) being estrus using the vaginal cytology

method of detection. Guimarães, et al. [10] reported postpartum estrus to be 12.04 days (7-24 days). The length of time between parturitions were 126.03 days (109-184 days) in the study carried out by Guimarães, et al. [10]. During the postpartum estrus period, 80.95% of copulations (from 18 females) were fertile and ended in successful pregnancy Guimarães, et al. [10]. Korz [11] reported that 2-3 parturitions per year is possible with the Agouti. Brown-Uddenberg [12] reported new born agouti females weighing between 210g-355g while male offspring weighed 225g- 308g. At 8 weeks of age, female offspring weighed 1088.9g- 1306.6 g and males at 8 weeks old were 723.5g- 1298.8g Brown-Uddenberg [12]; Brown-Uddenberg, et al. [13]. Asibey [1] suggested a weaning age of 8 weeks old while Smythe [14] recommended 12 weeks old. Mohammed [15] reported on 10 dams with 22 offspring experiencing weaning periods of 1, 2, 3 and 6 weeks where dams did not re conceive immediately when enduring extended weaning periods of 1 week. Mohammed, et al. [16] reported on 80 parturitions where dams lost -1.5 g/d, - 1.6 g/d, - 1.6 g/d and - 4.7 g/d after experiencing the weaning periods of 1, 2, 3 and 6 weeks respectively. The weaning periods of 1, 2, 3 and 6 weeks were applied and dams had successive parturitions of 15.9, 17.9, 20.4 and 23.9 weeks Mohammed, et al. [16]. Mohammed, et al. [16] concluded that weaning offspring at 7 days old allowed dams to:

1. Loose less body condition.
2. Reconceive faster.
3. Have a shorter parturition interval.

2. METHODOLOGY

(This methodology was adopted and modified from Mohammed [15]; Mohammed, et al. [16]; Mohammed and Garcia [17] (unpublished); Mohammed and Garcia [18] (unpublished)).

2.1. Location, Climate and Time Frame

The data collection took place at the University of the West Indies Field Station (Intensive Agouti Production unit), located at Mt. Hope (Latitude 10.6468 and Longitude -61.4228), Trinidad. The temperatures within the unit ranged from 22.4°C to 33.5°C. The unit was established on July 31st, 1986 and had a total head count of approximately 147 Agouti of different physiological states between 2015 to present. The observations were carried out from December 2016 to April 2018.

2.2. Animal Housing and Management

The animals were housed in an intensive type system (similar to the battery cage system of rabbits). Animals were housed individually in steel cages (15" length, 18" width and 15" high) and supplied with water and food on a daily basis [13]. Pens were cleaned and washed while animals were fed, watered and observed daily.

2.3. Gestation, Parturition and Weighing of Dams

Data was collected from dams which started by the recognition of pregnancy. This was done by visual observation and experience of the technical staff of the unit. Recognition of pregnancy was usually confirmed by an increase in abdominal size (round and swings when walking) and the protrusion of teats (8) from the chest to abdominal area. When females were observed and confirmed to be pregnant, they were gently isolated and were placed into bigger cages (24" length, 18" width and 15" high). A red brick with two distinct holes was placed into each pregnant dam's cage as well as fresh cut forages (grasses and tropical legumes) was used as bedding and for inoculation of the gut microflora.

Pregnant dams were weighed daily (with extreme care) from the day of isolation until the day of parturition and 3 parturitions after (during pre-wean and post wean periods). Hence the study has data on 12 (2) year old females for 4 parturitions (total 48 parturitions). This experiment lasted approximately 485 days. This detailed

weighing process enabled us to get a long term understanding of how much weight (g) was added by conception and pregnancy and how much weight (g) was lost due to parturition and a 7 day weaning period [16]. It was confirmed in the study by Mohammed, et al. [16] that weaning at 1 week was beneficial for the 1) good growth of offspring 2) earlier time of conception for females and 3) body condition was least affected by the earliest weaning period of week.

Females were caught using the “bag method” of catching and restraining. This method facilitated that both the animal and the handler had a barrier between them for their protection. The bag was folded down to half its length, with both hands controlling the entry point. The female was scooped into the bag gently (with experience) and then weighed.

The weighing process was done by taring the bag (app. 102.5g) and then weighing the females individually (AMIR Digital Kitchen Scale, 5000g, in increments of 1g). Dams’ weights were recorded and stored on a spread sheet from the time of observed pregnancy until 4 parturitions were recorded. Data such as total litter size at parturition, individual weight of litter mates and sex within litters were also recorded.

2.4. Pre Parturition Feeding Management

Dams were fed 1000g of fresh fruit per day, usually the fruit in season or abundance (farm grown). The fruits fed were mangoes (*Mangifera indica*), pumpkin (*Cucurbita*), cucumbers (*Cucumis sativus*) and papaya (*Carica papaya*). Tropical forages such as *Trichanthera* (*Trichanthera gigantea*) and *Leucaena* (*Leucaena leucocephala*) were also fed (no more than 50% of the total DM diet). Dams were also allowed 100g of concentrate per day (Ration A 17% Min. CP) during the conception and early gestation period. During the gestation period dams were also allowed mineral and vitamin supplements twice per week.

2.5. Post Parturition Feeding Management

Dams were fed 1000g (+ 100g extra per offspring) of fresh fruit per day for the 7 days pre weaning period, usually the fruit in season or abundance (farm grown). The fruits fed were mangoes (*Mangifera indica*), pumpkin (*Cucurbita*), cucumbers (*Cucumis sativus*) and papaya (*Carica papaya*). Corn (*Zea mays*), cassava (*Manihot esculenta*) and coconuts (*Cocos nucifera*) were added to the post parturition diet. Tropical forages such as *Trichanthera* (*Trichanthera gigantea*) and *Leucaena* (*Leucaena leucocephala*) were also fed but in very limited amounts (<20% of the total DM diet). Dams were also allowed 100g of concentrate per day (Ration B 18% Min. CP) during the late gestation (3rd trimester) and early parturition (7 days postpartum) period. Dams were also allowed vitamin and mineral supplements.

2.6. Analysis of Data

The data was collected from 12 (2 year) old multiparous dams. The length of the study was approximately 485 days where 4 parturitions were recorded for each dam. Hence there were 48 parturitions in total with 100 offspring being born.

1. Live weight was judged by weighing animals (g) from a) recognition of pregnancy b) through parturition and c) post parturition to conception to successive parturition.
2. Parturition interval was calculated by the time in days between both parturitions minus the 104 days for gestation.
3. Litter size for 4 parturitions from 12 dams were recorded and compared.
4. Average offspring birth weight and total litter weight were recorded and compared.
5. Sex ratio within each litter born per parturition were recorded and compared.

3. RESULTS

Table-1. Average amount of days to conception after 7 day weaning for 4 consecutive parturitions.

Dam ID	Days to 1st part	Days from p1 to p2	Days from p2 to p3	Days from p3 to p4
1	123	123	120	115
2	122	118	111	113
3	123	120	118	111
4	121	122	125	109
5	126	124	116	110
6	111	110	121	116
7	122	120	118	114
8	119	120	121	113
9	115	120	121	114
10	122	116	110	119
11	109	110	109	115
12	117	113	109	109
Average days/part.	119	118	117	113
St. dev.	5.18	4.77	5.52	3.01
St. err	1.50	1.38	1.59	0.87
Assumed gestation	104	104	104	104
Days postpartum	15.2	14	12.6	9.17
Weaning @ 7 days	7	7	7	7
Days to conceive	8.17	7.00	5.58	2.17

Table-2. Final body condition of dams after 4 parturitions with a 7 day weaning period.

Dam ID	P 1 (g)	P 2 (g)	P 3 (g)	P 4 (g)	After 4 part. (g)	Post: Body cond. (g)
1	3301	3399	3504	3566	3443	265
2	3104	3213	3335	3397	3262	293
3	2857	2949	3060	3122	2997	265
4	2906	3015	3117	3179	3054	273
5	3034	3123	3235	3297	3172	263
6	3222	3322	3422	3484	3363	262
7	3043	3138	3238	3300	3180	257
8	2933	3037	3159	3221	3088	288
9	2948	3057	3169	3231	3101	283
10	2778	2874	3007	3069	2932	291
11	3044	3168	3279	3341	3208	297
12	3205	3286	3419	3481	3348	276
Average wt. of dams	3031	3132	3245	3307	3179	276
Std. dev.	157	156	153	153	155	13.9
Std. err	45.4	45	44.3	44.3	44.7	4.01

Table-3. Average individual birth weight for all 4 parturitions with a 7 day weaning period.

Dam ID	Ind. off (g) wt p1	Ind. off (g) wt p2	Ind. off (g) wt p3	Ind. off (g) wt p4
1	208	217	225	230
2	197	207	216	221
3	184	192	201	205
4	186	196	204	209
5	193	202	210	215
6	204	213	221	226
7	194	202	211	215
8	188	197	206	211
9	189	198	207	212
10	179	188	198	203
11	194	204	213	218
12	203	211	221	225
Avg. Offspring wt.	193	202	211	216
Std. dev.	8.60	8.59	8.52	8.55
Std. err	2.48	2.48	2.46	2.47

Table-4. Average litter size over the 4 parturitions with a 7 day weaning period.

Dam ID	Litter size p1	Litter size p2	Litter size p3	Litter size p4	Avg. lit size/dam
1	2	2	2	3	2.25
2	1	2	2	3	2
3	2	2	2	2	2
4	3	2	1	2	2
5	2	2	3	2	2.25
6	1	2	2	3	2
7	2	1	2	1	1.5
8	1	2	2	2	1.75
9	2	2	3	3	2.5
10	2	3	2	2	2.25
11	2	2	2	3	2.25
12	1	3	3	2	2.25
Avg. Lt. size	1.75	2.08	2.17	2.33	2.08
Std. dev.	0.62	0.51	0.58	0.65	0.59
Std. err	0.18	0.15	0.17	0.19	0.17

4. DISCUSSION

Table 1 showed that weaning at 7 days [16] had a positive impact on the length of time it takes for dams to give birth and reconceive for a successive parturition. Intervals ranged from as long as 119 days to as short as 113 days ([10] reported 126.03 days). Hence it is possible to get 3 parturitions per year (113 x 3= 339 days) while enforcing the 7 day weaning period as a reproductive management tool. Using a gestation period of 104 days, theoretically the days “open” ranged from 9 to 15 days ([10] reported postpartum estrus of 12.04 days). Having offspring for 7 days (pre weaning period) of the open period, dams (12) had short intervals to conceive, which ranged from 2.17 to 8.17 days. Table 2 showed that dams increased their live body weight from parturition to parturition and had a final total gain of approximately 276g after 4 parturitions. As concluded from Mohammed, et al. [16], dams lost body condition (from 1.5g to 4.7 g per parturition) after enduring weaning periods of over 7 days. Weaning period length, lactation performance and litter size had severe impacts on dams’ body condition [16].

Table 4 showed that average litter size increased from 1.75 offspring/dam to 2.33 offspring/dam., which was a 33.14% increase in litter size per dam. Mohammed, et al. [16] found the average litter size per dam was 1.7 offspring per litter (136 offspring/ 80 parturitions). Table 5 showed the average offspring weight as a percentage of dam’s normal live weight increased from 5.47 % to 5.58 %. Mohammed et al 2018 reported offspring birth weight as a percentage of dam’s normal weight to be 5.35%. Table 3 showed that average offspring birth weight increased from 193g to 216g, which was an 11.72 % increase in average birth weight resulting in heavier offspring. Table 6 showed male to female ratios from 66.6% M: 33.3% F in parturition (1) to 50 % M: 50% F in parturition 4 which indicated an increase in the number of females being born. Table 7 showed an increase in triple born litters being 8.33% (1 of 12) of the total births in parturition (1) to 41.66 % (5 of 12) of the total births in parturition 4.

5. CONCLUSION

Weaning at 7 days allowed dams to:

1. Reconceive in a shorter period.
2. Allow 3 parturitions per year.
3. Loose less body condition postpartum.
4. Have larger litter sizes.
5. Have more females being born than male offspring per litter.
6. To have heavier offspring at birth.

Table-5. Average litter weight at birth as a percentage (%) of the dams' live weight over 4 parturitions.

Dam ID	Parturition 1 weights	Total litter wt @ p1	Parturition 2 weights	Total litter wt @ p2	Parturition 3 weights	Total litter wt @ p3	Parturition 4 weights	Total litter wt @ p4
1	3801	416	3936	434	4053	451	4126	691
2	3604	197	3750	413	3884	432	3957	662
3	3357	367	3486	384	3609	401	3682	411
4	3406	559	3552	391	3666	204	3739	417
5	3534	387	3660	403	3784	631	3857	430
6	3722	204	3859	425	3971	442	4044	677
7	3543	388	3675	202	3787	421	3860	215
8	3433	188	3574	394	3708	412	3781	422
9	3448	377	3594	396	3718	620	3791	635
10	3278	359	3411	564	3556	395	3629	405
11	3544	388	3705	408	3828	426	3901	653
12	3705	203	3823	632	3968	662	4041	451
Individual lt. size as a % MBW		5.47		5.51		5.56		5.58

Table-6. Sex ratio of offspring at birth for all 4 parturitions.

Dam ID	Litter size p1	Litter size p2	Litter size p3	Litter size p4
1	2	2	2	3
2	1	2	2	3
3	2	2	2	2
4	3	2	1	2
5	2	2	3	2
6	1	2	2	3
7	2	1	2	1
8	1	2	2	2
9	2	2	3	3
10	2	3	2	2
11	2	2	2	3
12	1	3	3	2
Total offspring	21	25	26	28
Males	14	14	13	13
Females	7	11	13	15
% Females	33	44	50	50

Table-7. Birth type of offspring over 4 parturitions

Litter sizes	Birth type of p1	Birth type of p2	Birth type of p3	Birth type of p4
Single	4	1	1	1
Twins	7	9	8	6
Triplets	1	2	3	5
Total litters	12	12	12	12
% Single	33%	8%	8%	8%
% Double	58%	75%	67%	50%
% Triple	8%	17%	25%	42%
Total offspring	21	25	26	28

6. RECOMMENDATIONS FOR FUTURE WORK

- 1) Measuring the rate of growth (by sex and litter size) of offspring until adulthood (360 days) by allometric measurements using Gompertz, Logistic and von Bertalanffy equations.
- 2) Creating a diet for each physiological state (focusing on dams and offspring) of the production cycle.
- 3) Defining the age at slaughter, dressing percentage and carcass quality of male agouti.
- 4) Re-defining target performance coefficients for intensive production and creating new criteria for phenotypic selection for intensive breeding.

Funding: This study received no specific financial support.

Competing Interests: The authors declare that they have no competing interests.

Contributors/Acknowledgement: Authors would like to thank the staff of the Department of Food Production in the Faculty of Agriculture at the University of the West Indies for their support and encouragement. They would also like to thank the staff at the Agouti unit of the University Field Station for their assistance in keen animal management practices and great considerations for animal welfare.

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