

The effect of date fruit on puberty and sexual maturity in heifers

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Abstract

This study was conducted on 15 cross breed heifers at age 5-month-old from the period of the 1st of February 2018 to 1st of December 2018. Total 15 heifers were divided randomly two groups, first one was the date treatment (T1) and the other was control treatment (T2), T1 was supplemented with basal ration in addition to the tow Kg of dates daily, while T2 was supplemented with chief ration only. Body condition score, body weight, hormonal assay, bull display and field observation were used for puberty determination. While body weight, body condition score, progesterone estimation, rectal palpation and ultrasonography were used for pregnancy determination at 60 days. Ultrasonography was used to confirm pregnancy and certain maturity of heifers. There was used 3.5MHz for prop in rectal palpation with special gel for the prop in ultrasonographic examination. The aim of current study was to accelerate puberty and sexual maturity in heifers that was fed on dates. The results revealed that there was a significant effect ($P \leq 0.01$) for the date treatment (T1) on control treatment (T2) in acceleration of puberty and sexual maturity. Heifers were reached puberty and maturity age at 7.8 and 9.8 month old for T1 and 11.4 and 16.2 month old for T2 respectively. The response of heifers for advance of puberty and sexual maturity is fast in 60% and moderate in 30% of heifers. Only 10% of heifers were not responded to date supplementation.

Keywords: Dates, puberty, maturity, weight, and hormonal assay.

Introduction

The scientific name of date palm was *Phoenix dactylifera*. Sugar is the highest proportion of date fruits. Date increases the vitality of the brain and regulates the blood sugar. Date increases sexual activity to contain phosphorus, (1). Date fruit activates immunity and thyroid gland and Regulates blood acidity. Date was one of the important fruit treats anemia to contain a high concentration of iron (4). Provides the body with energy and facilitates digestion. It strengthens the nervous system to contain phosphorus, iron, calcium potassium, magnesium and sodium. Date enhances uterine involution and reduces hemorrhage after parturition. Date is containing oxytocin; oxytocin facilitates birth and regulates uterine contraction during parturition stages (3). Date activates spermatogenesis in the male and oogenesis in female (2). Date is consisting of 70% carbohydrate, 17% water, 2.5% fat, 5% fibers and 1.3% mineral and salts and contains quantities of alkaloids, polyphenols, tannins, minerals and vitamins (4). Puberty in heifers is meaning ability of female to produce ova and sufficient quantities of sex hormones to enable a female for reproduction. Puberty is a gradual process of maturation of reproductive systems and endocrine glands and it does not occur suddenly to enable the heifer for successful reproduction. The onset of puberty was regulated by hypothalamus. The puberty onset was affected by many factors such as species, age, genotype, growth rate, body weight and energy status. In heifers the average of pubertal age is 12 months (5).

When the weight of heifer is about 65% of adult weight, heifers were reached

maturation. The average sexual maturity age in cows is about 18 months and it is detected at the first real pregnancy (29). The variation is very high among breeds of cows in age and weight (14). The determination of maturity in heifers is very important due to the economic effect. The sexual development in reproductive systems had strong relationship with nutrition. The maturity weight and age in beef cattle are more than in the dairy cattle, the beef heifer was reached maturity weight and age at about 4-5 years old but the dairy heifer was reached the complete adult age and weight at about 2 years old. The specific weight of mature heifer is unknown, for that, scientists and researchers were discovered the percent of herd average weight (PHAW) as accepted indicator for weight maturity and its near to 400-500 Kg in beef cattle, and maturity index (MI) is another method for maturity determination which consists of five factors: dam's age and dam's mature weight in addition to birth weight and heifer's age and nutritional state. An individual is becoming more profitable when individual characteristic is presence such as weight and age of dam and weight and age of heifer with good nutritional regime (32). The study is aimed to accelerate and determine puberty and sexual maturity in heifers that supplemented dates.

Materials and Methods

Experimental animals

15 heifers 5 months old were divided randomly in to two treatments, the first treatment contain 10 females were fed with: 49% rough straw, 15% green gross, 15% concentrated ration and 1% vitamins and salt (basal ration) plus 2 kg dates supplementation / animal represented as 20% of the ration till puberty. The changing

of ration may be done weekly if it is necessary. And the second treatment consist of 5 heifers were fed basal ration only without date supplementation which was regarded as control treatment. To avoid acidosis, gradual feeding of dates is very important, the date amount was increased 0.5 Kg weekly to reach 2 Kg daily, the meal of date was divided to two meals one at morning and the other at evening.

Blood collection:

During the experiment period, blood samples were collected at three times: at pretreatment for FSH and estrogen estimation in the plasma, at puberty age for estimation of FSH and estrogen hormones and at maturity age for estimation of progesterone in the plasma, and the maturity was confirmed by pregnancy diagnosis. The collection of blood samples were collected after control of the female and sterilization of jugular groove, 5 ml of blood is collected from jugular vein, centrifuged for 10 minutes at 3000 rpm and finally hormonal assay was done with minividas instrument. Puberty and sexual maturity were determined with FSH, estrogen and progesterone estimation, body weight, body condition score, bull display and field observation. All heifers were weighted at same three times of blood collection.

Body condition score is performed before feeding and drinking of water, heifers scoring from 1-5 score by inspection, and regarded the grade 1 for the thinner female and grade 5 for the fitter female, the scoring is performed at the same three times of weight. Field observation is recorded during the walking among the animals daily to record the estrus signs and confirmed with the other remembered methods to determine

the puberty and then exposure to male to test the acceptance together.

Sexual maturity was determined by first real pregnancy, the pregnancy was diagnosed with body weight and body condition score in addition to rectal palpation and progesterone estimation and confirm with ultrasonography, body weight, body condition score and progesterone estimation were performed to determine of maturity in same way of puberty determination, the inseminated females were tested at 60 day after insemination date with rectal palpation and ultrasonography.

Statistical analysis

The data were analyzed statistically with SAS- statistical Analysis System (34) to study effect of date supplementantation on the advance of puberty and sexual maturity, using Completely Randomized Design (CRD) and compares the significant effect between means with by use of the least square means Duncan (11).

Results

Results shows that there was no significant effect between T1 and T2 on body weight and scoring at pretreatment day and body weight and scoring in puberty age, the result also shows that there is a significant effect $p < 0.05$ for T1 on T2 in weight at puberty 151.80 ± 2.37 Kg and 146.40 ± 2.83 Kg, and there is a significant effect $p < 0.05$ for T1 on T2 in scoring at maturity 4.14 ± 0.07 and 3.84 ± 0.12 respectively table 1. The results mention that no significant effect between T1 and T2 in FSH and estrogen at pretreatment age and puberty age, but there is a significant effect $p < 0.05$ in FSH (61.57 ± 3.74 and 28.06 ± 2.38) ng / ml and estrogen (17.44 ± 0.90 and 10.40 ± 1.24) pg/

ml) between T1 and T2 respectively in blood plasma at puberty. One of the sexual maturity determination was estimation of progesterone level in the blood plasma at the maturity age, the results showed a significant effect ($P \leq 0.01$) for T1 on T2 in progesterone level 5.11 ± 0.47 and $1.64 \pm$

0.80 ng/ml respectively at maturity age, and there is a significant effect ($P \leq 0.01$) for T1 in advance of puberty and maturity age 7.8 ± 0.48 and 9.80 ± 0.48 months on T2 in advance of puberty and maturity age 11.4 ± 0.60 and 16.20 ± 1.80 month respectively table 2, 3 and 4.

Table 1: Effect of date fruit on weight and scoring in pretreatment day, puberty and maturity in heifers.

Treatment	No.	Means					
		Weight at pretreat day-kg ⁻¹	Weight at puberty/kg	Weight at maturity/kg	Scoring in pretreat day	Scoring at puberty	Scoring at maturity
1 st (T1)	10	100.60 ± 2.0 a	151.80 ± 2.37 a	212.10 ± 2.68 a	1.05 ± 0.05 a	3.31 ± 0.06 a	4.14 ± 0.07 a
2 nd (T2)	5	103.20 ± 1.71 a	146.40 ± 2.83 a	202.00 ± 3.31 b	1.00 ± 0.00	3.10 ± 0.10 a	3.84 ± 0.12 b
Means		101.9 ± 1.15	149.1 ± 2.16	207.05 ± 2.91	1.025 ± 0.02	3.21 ± 0.53	3.99 ± 0.45
Level of significance		N. S	N.S	*	N. S	N. S	*

N.S = non significance, * = Level of significance ($P \leq 0.05$), kg = kilogram, (T1) date fruit treatment and (T2) = control treatment.

Table 2: Effect of date fruit on FSH ng-ml⁻¹ and estrogen pg-ml⁻¹ in pretreatment day and puberty and progesterone ng-ml⁻¹ in maturity and advance of puberty sexual maturity in heifers.

Treatment	No	Means						
		FSH ng-ml ⁻¹ in pretreat . day	FSH ng-ml ⁻¹ in puberty	Estrogen pg-ml ⁻¹ in pretreat. day	Estrogen pg-ml ⁻¹ in puberty	Progesterone ng-ml ⁻¹ in maturity	Age in puberty /month	Age in maturity/ month
1 st (T1)	10	16.87± 0.36a	61.57± 3.74a	6.91± 0.22a	17.44± 0.90a	5.11± 0.47a	7.80± 0.48b	9.80± 0.48a
2 nd (T2)	5	16.78± 0.46a	28.06± 2.38b	7.01± 0.20a	10.40± 1.24b	1.64± 0.80b	11.40± 0.60a	16.20± 1.80b
Means		16.68± 0.39	44.81± 2.81	6.96±0.2 1	13.92±1.1 1	3.38±0.63	9.60±0. 56	13.00±1. 12
Level of significance		N.S	*	N.S	*	**	**	**

N.S = non significance, * = Level of significance ($P \leq 0.05$), ** = Level of significance ($P \leq 0.01$), ng = nanogram, pg = picogram (T1) date fruit treatment and (T2) = control treatment.

Table 4. Body condition score (BCS), weight /kg, progesterone (P4) ng-ml⁻¹ and estrogen (E2) pg-ml⁻¹ in plasma related with puberty and maturity age in date fruit treatment.

Animal No.	BCS	Weight/ kg	P4 ng- ml ⁻¹	E2 pg- ml ⁻¹	Puberty age/month	Maturity age/ month
1	4.2	212	4.84	38.26	7	9
2	4.2	216	5.21	36.58	7	9
3	4.0	207	4.98	37.28	7	9
4	3.8	196	1.18	36.76	12	14
5	4.5	210	5.47	39.16	7	9
6	4.5	212	4.73	38.18	7	9
7	4.0	218	5.64	40.14	8	10
8	4.0	215	6.11	36.85	8	10
9	4.2	209	5.86	38.76	7	9
10	4.0	226	6.08	22.18	8	10
Average	4.14	212.1	5.11	36.41	7.8	9.8

Table 5. Body condition score (BCS), weight, progesterone (P4) ng/ml and estrogen (E2) pg-ml⁻¹ in plasma related with puberty and maturity age in control treatment.

Animal Number	BCS	Weight/ kg	P4 ng/ml	E2/pg/ml	Puberty age/month	Maturity age / month
1	3.8	205	0.70	22.43	13	19
2	3.8	197	0.96	19.91	12	18
3	4.3	213	4.84	35.30	9	14
4	3.8	201	0.73	21.18	12	18
5	3.5	194	0.98	20.80	11	17
Average	3.84	202	1.49	23.92	11.4	16.2

Discussion:

The result refers that there is a significant effect in body weight (212.10 ± 2.68 and 202.00 ± 3.31) and scoring (4.14 ± 0.07 and 3.84 ± 0.12) in maturity age between date treatment and control respectively table (2). Due to date supplementation, because date contains many types of minerals such as phosphorus, addition of phosphorus to the ration was increased weight gains (21), and the date has antioxidants activity which increases growth cells, immunity, body condition score, body weight and fertility, (25). There is a significant effect between date and control treatment in FSH (61.57 ± 3.74 and 28.06 ± 2.38) ng / ml and estrogen (17.44 ± 0.90 and 10.40 ± 1.24) pg/ ml) in blood plasma between puberty and maturity age respectively table (1) and there is a significant effect for date treatment cambered with the control treatment in progesterone level (5.11 ± 0.47), (1.64 ± 0.80) for date and control treatment respectively table (2), the date is containing 22.5 mg Indium (In), In is supporting the hormonal balance of the body and increasing hormone production, In has a positive effect on the master hormone

producers (pituitary gland) which is responsible for maintaining the production and balance of the body hormones and also effect on the hypothalamus. In improve the function of hormonal systems and had reversal signs of aging. In Cause the releasing of a cascade of youth promoting hormones such as growth hormone, estrogen, testosterone by stimulating the hypothalamus-hypophysis biofeedback loop (28).

There is a significant effect for date treatment in advance of puberty and maturity age 7.3 and 9.8 months old respectively on control treatment 11.4 months old for puberty and 16.20 months old for maturity, table (2,4 and 5). Because of dates were led to accelerate puberty and sexual maturity, due to containing: high proportion of carbohydrate 70.3% (glucose 34.6, fructose 23.3 and sucrose 2.4%) and little amount of fat 2.6%. Precocious puberty and sexual maturity is caused by high proportion of carbohydrate, a series of experiments on heifers show that precocious puberty may be induced by feeding a high-energy diet such as carbohydrate in heifers at three months of

age (14,15 and 16). Gasser (14) reported that precocious puberty and sexual maturity were initiated by a high concentration of carbohydrates in the ration. Indium 22.5 mg, the hypothalamus and the pituitary were affected by Indium positively (28). Iron (Fe) 140.8 mg, iron is a part of enzymes involved in the collagen synthesis and some neurotransmitters and Fe is essential for energy metabolism and respiration, Fe improves healthy of heifers and decreases anemia and increases immunity that leads to increases in body gain which leads to advance of puberty and sexual maturity (35). Phosphorus (P) 720 mg, a phosphorus rich diet is necessary for ovarian function and increased fertility in cattle (20). Phosphorus intake is increased fertility in cow (19). Holzochuh (21) reported that P is increased weight gains. Zinc (Zn) 0.4mg, Zinc is increased hormonal production, enzyme activity, vitamins synthesis and energy production, in addition to another physiological processes related to reproduction (6). Underwood and Suttle (37) reported that Zinc is involved in reproductive performances of animals. Potassium (K) 1980-2480 mg, Potassium is increasing body weight that leads to advance of puberty and sexual maturity. P is necessary for muscle, ovaries, follicular and uterine fluid and heartbeat, and potassium is taken part in maintaining of water balance, osmotic pressure and acid-base balance, and play a role in metabolism of carbohydrates and proteins, (7). Calcium (Ca) 130-170 mg, Calcium is necessary for puberty and sexual maturity because it had a role in many physiological functions such as: oocyte maturation, meiotic maturation, fertilization and embryonic development in addition to activation of proteases and DNA-fragmenting enzymes (8). Manganese (Mn) 53.6 mg, Manganese is necessary for

growth and development. Manganese is responsible for the production of mucopolysaccharides and glycoproteins and other important functions lead to advance of puberty. Manganese helps choline biosynthesis, choline is increasing fat metabolism in the liver to produce energy, and this situation is necessary for growth and early reaching puberty in heifers (18). Rubidium (Rb) 45.4 mg, Rubidium supports potassium function in the muscles and stimulates metabolism (23). Ruthenium (Ru) 104.6, Ruthenium removes toxic metals in the body organs and prevents accumulation of them in the body and leads to improving animal healthy (26). Cadmium (Cd) 14.5, Cadmium activates Bacteria in rumen and some enzymes (13). Bismuth (Bi) 22.8mg, Bismuth is improved protein synthesis by binding to the zinc and iron sites (22). Cooper (Cu) 1.2 mg, Cooper has an antioxidant action and prevent DNA cell damage, that leads to increasing in body weight (24). Lead (Pb) 3.2mg, Pb increases the hemoglobin synthesis and maintains blood pressure, central nervous system and utilization of vitamin D and calcium (31). Magnesium (Mg), one of the important functions from many functions of Magnesium, Mg increases activity of the hypothalamic-pituitary-adrenal axis, and appetite. (12). Vitamin A1600 IU, Vitamin A is involved in the formation of estradiol-17 b in tertiary follicles and progesterone in corporalutea. Vitamin B complex more than 1.5 mg, B1 (Thiamin) has a role in nerve function and helps to convert glucose into energy. B2 (Riboflavin) was necessary of energy production. B3 (Niacin) and B5 (Pantothenic acid) increases steroid hormones production and metabolizes carbohydrates, proteins and fats. B6 (Pyridoxine) activates carbohydrate metabolism; development and steroid

hormone production. B7 (Biotin) is necessary for fat and glycogen synthesis. B9 (Folic acid) helps in DNA synthesis and growth. Vitamin B12 (cyanocobalamin) and B9 play a role in cell growth and DNA synthesis and formation of proteins and carbohydrate (38). Amino acids prevent P4 output and delayed ovulation, Amino acids increase the onset of puberty and sexual maturity, and Amino acids affect the ovarian steroid genesis and maintain ovarian cycle, fertility, development, endocrine function and reproductive performance (33). Amino acids enhance ovulation and increase body weight (36). Chlorine and Sodium, Chlorine with sodium improve appetite and body weight. Sulfur, Sulfur is interfering with protein synthesis leads to increase in body weight (27). Oxytocin, oxytocin stimulates growth and cellular proliferation and modulate mitotic activity in various organs, inhibits release of adrenocorticotrophic hormone and cortisol indirectly. Oxytocin is increased sexual receptivity and causes lysis of corpus luteum (30). Alkaloids and tannins, Alkaloids and tannins improve health of animals by preventing infection of parasites, bacteria, viruses and fungi (10). Pcoumarique acids, P-comarique acid has many biological functions such as anti-oxidant, immunomodulatory effect, anti-inflammatory, antiviral, antimicrobial, anxiolytic, analgesic effect and antipyretic and direct scavenger of reactive oxygen species (25). Terpenoids, terpenoids play a role in growth regulation (17). Antioxidant effectiveness, date is antioxidant diet that leads to improve body weight which cause advance of puberty (39). One kilogram of date contains 3,000 kilocalories (2), for these actions of date fruit; it is causing acceleration in puberty and sexual maturity.

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