EFFECT OF FEEDING LEVEL AND YEAST SUPPLEMENTATION ON CHARACTERISTICS ON PUBERTY OF FRIESIAN HEIFERS

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ABSTRACT

A total of 36 growing Friesian calves with average body weight of 175.6±2.34 kg and 10.47±0.30 months of age was assigned randomly into three groups (12 heifers each) fed on three feeding levels 80, 100 and 120% of NRC requirements. Each group was further divided into two equal subgroups, namely control and supplemented with 10 g/head/day dry baker yeast (DBY). The results of live body weight (LBW) of heifers at puberty were not significant in all groups. Puberty age was significantly ($P<0.05$) earlier by about 13.5 and 21.5 days in heifers fed 120% of NRC with or without DBY diets than the control group with or without DBY, respectively. LBW on heifers at 1st service was not significant. Average age at 1st service was earlier by about 56 and 73 days in heifers fed 120% with or without DBY diets than that other groups. The results revealed nearly similarity in the ovarian activity of heifers, although the ovulatory cycles tended to be slightly longer in heifers fed 120% of NRC with or without DBY than the control (100% of NRC with or without DBY) group (20.9 and 21.4 vs. 21.6 and 22.3 days). During pre-puberty stage, concentration of Pg significantly ($P<0.05$) decreased by decreasing feeding level from 100 to 80%, while it was not affected significantly by increasing feeding level from 100 to 120% or DBY supplementation. At 1st oestrus and early pregnancy stage, Pg concentration was not affected ignorantly by treatment group or DBY supplementation. The obtained results indicated the beneficial effect of feeding level as found by increasing feeding level from 100 to 120%, whereas heifers in both groups showed similar CR (83.3%) and NS/C (1.4). DBY supplementation significantly ($P<0.05$) increased CR for all feeding levels, from 66.7 to 83.3% for 100% feeding level, from 33.3 to 50.0% for 80% feeding level and from 83.3 to 100% for 120% feeding level.

In conclusion, feeding Friesian heifers during pre-puberty on levels 100 and 120% with DBY improved puberty and reproductive performance in term of shortening age of puberty and 1st service, SP, NS/C and increased conception rate in Friesian heifers.

Kaywords: *Heifers, feeding level, dry bakers yeast, puberty, Progesterone.*

INTRODUCTION

Age and weight at which heifers attained puberty are important reproductive measurements in dairy production, since extreme delay in the occurrence of 1st oestrus might lower the heifers breeding efficiency. In Egypt, where Friesian heifers are reared under subtropical conditions, age at puberty ranged from 12.4 and 16.7 monthsof age (**El-Keraby, 1970 and Swiefy, 1988**). While, age at first service may reach 24.9 months of age in Friesian heifers (**Mohamed *et al.*, 1965**).

Using yeast culture as dietary supplements beneficially affects reproductive performance of buffalo cows (**Ibrahim, 2004**), (**Gharab, 2007**) Friesian heifers and buffalo heifers, **Abdel-Latif (2005).**

Therefore, the carrent study was undertaken to evaluate the effect of feeding level (80, 100 and 120% of NRC, 1988) with or without bakers yeast (10 g/head/day) supplementation on puberty characteristics of Friesian heifers.

MATERIALS AND METHODS

The experimantal work was carried out at Sakha Experimental Station of Animal Production, belonging to the Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture in cooperation with the Department of Animal Production, Faculty of Agriculture, Al-Azhar University, during the period from July 2004 to October 2005.

Animals:

A total of 36 growing Friesian heifers with average body weight of 175.6±2.34 kg and 10.47±0.30 months of age was assigned randomly into three main groups (12 heifers each) fed on three feeding levels 80, 100 and 120% of NRC requirements (1988). Each group was further divided into equal subgroups, with or without dry bakers yeast (DBY) at a level of 10 g/head/day.

Feeding system and dietary treatment groups:

Heifers in all dietary treatment groups were fed a basal ration composed of concentrate feed mixture (CFM), fresh berseem (FB) and rice straw (RS) during the winter season (November to May) and CFM, berseem hay (BH) and RS during the summer season (June to October). The CFM composted of 35% undecorticated cottonseed cake, 5% linseed cake, 25% ground yellow corn, 20% wheat bran, 10% rice bran, 3% molasses, 1% limestone and 1% common salt. Chemical analyses of different feedstuffs were performed according to the methods of A.O.A.C (1990) and are shown in Table (1).

Table (1): Chemical composition of different feedstuffs used in feeding Friesian heifers in all experimental groups.

Feedstuff	DM %	Composition of DM %					
		OM	CP	CF	EE	NFE	Ash
CFM	92.61	91.43	16.50	13.02	3.17	58.74	8.57
Fresh berseem	15.90	85.80	15.40	23.50	2.95	43.95	14.20
Berseem hay	91.21	87.20	12.85	26.65	2.70	45.00	12.80
Rice straw	90.31	83.59	2.56	31.79	1.09	48.15	16.41

Amounts of CFM for each treatment group were offered two times/day at 8 a.m. and 3 p.m. while, daily amount of RS was divided into two equal parts and given at 9 a.m. and 4 p.m.. Amount of FB or BH was offered once at 10 a.m.. Heifers were fed according to NRC (1988) allowances for growing heifers. Fresh and clean drinking water was available at all times. The amounts of different feedstuffs were adjusted biweekly to cover the requirements according to LBW.

The dietary supplementation of dry baker yeast (DBY) was conducted at a level of 10 g/head/day to CFM from the beginning of the experiment till conception. Amount of DBY was added to morning CFM.

Experimental procedures:

Throughout the experimental period from 10 up to 15 months of age, heifers were monthly weighed at morning before feeding, and then at puberty (1st oestrus) and 1st service. Also, age at puberty and 1st service were recorded.

Blood sampling:

Blood samples were twice weekly collected in clean test tubes via the jugular vein from all heifers in each group. Blood plasma was

separated by centrifugation of the collected blood at 15 *g* for 10 min, then plasma was kept frozen at –20 ^{0}C until determination of progesterone concentration.

Puberty incidence:

At the beginning of 15 months of age, oestrous activity of animals was daily detected out 12 hours during the period from at 7 a.m. and 7 p.m. by visually observation to recognize heifers in heat through standing for mounting the other heifers. The onset of first oestrus was used as an indicator for the onset of puberty, and then age and weight of heifers at puberty were recorded. Number and length of oestrous cycles occurred after puberty up to conception was recorded for each heifer in each group.

Service:

Heifers reaching LBW between 340 and ≥350 kg providing display oestrous behavior were artificially inseminated and weighed to determine LBW at the 1st service. This procedure was repeated for heifers returned to oestrus after the 1st service then service period (SP) and number of services per conception (NS/C) were recorded and in addition to LBW. Conception was performed by rectal palpation on day 60 post-insemination for animals non-returned to oestrus.

Concentration of Pg, Pg peak and interval to Pg peak were estimated prior to puberty and through the ovarian cycles.

Progesterone assay:

Blood samples were individually collected at pre-pubertal ages, 1st service and early pregnancy stage (2 weeks) for determination of progesterone (Pg) in blood serum at these times. Serum progesterone concentration was determined by the radioimmunoassay (RIA) using commercial kits (Diagnostic Products Corporation, Los Angeles, USA), according to **Kubasik *et al.* (1984)** by using solid phase radio-immunoassay (RIA) method, where in ^{125}I-labeled progesterone competes for a fixed time with progesterone in the sample for antibody sites. The antibody being immobilized to the wall of a polypropylene tube, decanting the supernatant suffices to terminate the competition and to isolate the antibody-bound fraction of the rediolabeled progesterone. Counting the tube in a gamma counter then yields a number, which coverts by way of a calibration curve to measure the progesterone present in the sample. Maximum concentration of Pg at the standerd curve was 60.0 ng /ml.

Statistical analysis:

Results were statistically analyzed according to **Snedecor and Cochran (1982)** using models procedure by **SPSS (2003)** for user's guide using one-way ANOVA as follows:

For LBW and age at puberty and 1st service as well as reproductive parameters and progesterone concentrations, the completely randomized design was used and the statistical model was:

$$Y_{ij} = U + A_i + e_{ij}$$

Where: Y_{ij} = Observed values; U = Overall mean; A_i = Treatment group and e_{ij} = Random error.

The significant differences among treatment groups were tested using Multiple Range Test according to **Duncan (1955)**.

RESULTS AND DISCUSSION

Live body weight and age at puberty:

Average LBW at puberty of heifers did not differ significantly between treatment groups and ranged 241.5 kg for 80% feeding level and DBY supplementation and 248.0 kg for 100% level and 100 with DBY. In spite the insignificant differences in LBW at puberty, all of heifers reached puberty between 200 and 250 kg for heifers fed 80% with and without DBY and those fed 100 or 120% without DBY. However, DBY supplementation resulted in incidence of the 1st oestrus in 16.6% of heifers reached at lighter LBW between 150 and 200 kg with feeding level of 100 or 120% (Table 2).

This may indicate slight effect of DBY on incidence of precocious puberty of heifers fed 100 and 120% feeding level. This was also associated with lighter mean weight of 1.5 and 4.5 kg for heifers fed 100 or 120% with than without DBY supplementation, respectively (Table 2).

In cattle, **Marston *et al.* (1995)** found that puberty weight of cow heifers was similar for animals fed supplemental soybean meal or low energy diets, being 290 and 296 kg. However, several factors were found to affect LBW of cow heifers at puberty including level of dietary energy (**Marston *et al.*, 1995**) and feed intake (**Hall *et al.*, 1995**).

Table (2): Average weight (kg) and age (day) at puberty and frequency distribution (%) of age for attainment of puberty in different dietary treatment groups.

Item	Dietary treatment group					
	100%		80%		120%	
	Without	DBY	Without	DBY	Without	DBY
Weight (kg) at puberty	246.5 ±12	248.0 ±15	245.6 ±9.8	241.5 ±20	242.0 ±19	246.5 ±26
Age at puberty (day)	426 ±8^{a}	412 ±6.8^{ab}	430 ±8.2^{a}	428.6 ±7.3^{a}	404 ±7.6^{b}	398 ±6.5^{b}
Frequency distribution (%) of age at puberty (day):						
300-350	-	16.6	-	-	33.4	33.4
350- 400	33.4	33.4	33.4	50.0	50.0	66.6
400-450	66.6	50	66.6	50.0	16.6	-

a and b: Means denoted within the same row with different superscripts are significantly different at $P<0.05$.

Results revealed that only increasing level feeding, regardless DBY supplementation from 100 to 120% significantly reduced age of heifers at puberty by about 22 days. However, decreasing feeding level to 80% insignificantly increased age at puberty by 4.5 days (Table 2).

On the other hand, DBY supplementation insignificantly reduced age at puberty for all feeding levels, but the higher rate of decrease was observed for 100% feeding level (about 14 days) as compared to 80 and 120% feeding levels (about 1.5 and 6 days, respectively). Pronounced effect of DBY was observed on frequency distribution of age at puberty for heifers fed 100% with DBY by attaining precocious puberty by about 17% of animals at age between 300-350 day. It is worthy noting that the earliest puberty age of heifers fed 120% with DBY (398 days) was associated with 100% of heifers showing the 1st oestruos between 300-400 days (Table 2).

In general, the results of puberty age in all groups ranged between 398 and 430 days, being lower than mean age at puberty (first ovulation) of Hereford x Friesian heifers (352 days) as reported by **Moran *et al.* (1990)**. However, in nearly similarity with the present results, age at puberty in cow heifers, as determined by measuring progesterone was 385 days **(Honaramooz, *et al.*, 1998)**.

The present age at puberty of Friesian heifers was found to be affected by feeding level rathr than DBY supplementation. In this

respect, **Shahin (2004)** found that age at puberty in Egyptian buffalo heifers was significantly (P>0.01) earlier in heifers fed 120% TDN (424 days) than those in 100% (433 days) and 80% (458 days) TDN. Also in cow heifers, **Hall *et al.* (1994)** recorded that heifers fed high energy level were younger (P<0.001) at puberty than those fed moderate level.

Live body weight and age at 1st service:

The differences in LBW at 1st service among treatment groups were not significant and ranged between 349.7 and 355.3 kg (Table 3). In agreement with the present results, **Shahin (2004)** found that buffalo heifers fed 120% TDN level were insignificantly heavier at 1st service than those fed 100 and 80% TDN levels, being 371.1, 365.2 and 356 kg, respectively.

Table (3): Average live body weight (kg) and age (day) at 1st service and frequency distribution of heifer age in different treatment groups.

Item	Dietary treatment group					
	100%		80%		120%	
	Without	DBY	Without	DBY	Without	DBY
Live body weight (kg)	352.9 ±23.5	349.8 ±31.2	355.3 ±35.6	353.6 ±33.5	349.7 ±22.5	356 ±27.8
Age (day)	601 ±22^{a}	568 ±19^{ab}	631 ±25^{a}	573 ±20^{ab}	528 ±15^{b}	512 ±18^{b}
Frequency distribution (%) of different age at 1st service (day):						
500 - 550	16.6	33.4	-	16.6	66.6	50
550 - 600	50	50	33.3	50	33.4	50
600 - 650	33.4	16.6	66.7	33.4	-	-

a & b: Significant group differences at P<0.05.

Average age at 1st service was significantly (P<0.05) earlier by increasing level of feeding from 100 to 120% by 73 days. However, decreasing feeding level insignificantly delayed age at 1st service by about 30 days. However, DBY supplementation did not affect significantly age at 1st service (Table 3). The earliest age at 1st service for heifers fed 120% with or without DBY was associated with the highest frequency distribution (50 and 66.6%, respectively) of heifers inseminated for the first time at age between 500-550 days and all heifers (100%) were served for the first time at age between 500 and 600 days (Table 3). Similarly, **Shahin (2004)** found that age at 1st

service was significantly (P>0.05) earlier in buffalo heifers fed 120% TDN (516.4 days) than those fed 80% TDN level (581.3 days).

Ovarian activity:

The present results in Table (4) revealed insignificant differences in the ovarian cycle length of heifers by changing feeding level or DBY supplementation, ranging between 21.4 and 23.4 days. Such trend was associated with numerous cycles by reducing feeding level from 100 to 80% and fewer ones by increasing feeding level to 120%. As a result of showing all heifers in each group ovarian cycles, average number of cycles had similar trend to the total number of cycles (Table 4).

Table (4): Number and average length of ovarian cycle of heifers in different treatment groups from puberty to conception.

Dietary treatment group		N	Total	Average No. of cycles/animal	Ovarian cycle length (d)
Feeding level	Supplement				
100%	Without	6	44	7.33	22.3±1.6
	DBY	6	37	6.17	21.6±1.4
80%	Without	6	48	8.0	22.8±1.8
	DBY	6	38	6.33	23.4±1.2
120%	Without	6	32	5.33	21.4±1.2
	DBY	6	29	4.83	20.9±1.1

N: Number of animals showing ovarian cycles.

Group differences in ovarion cycle length are not significant at P>0.05.

As affected by feeding level, frequency distribution of ovulatory cycles in normal type increased by increasing feeding level and decreased by its reducing. However, DBY supplementation markedly increased incidence of the normal cycles. The rate of increase was the higheast with 80% feeding level and the lowest with 120% feeding level (Table 5).

It of interest to note that average number of ovarion cycles was negatively attributed to conception rate and number service per conception, which will be discussed thereafter.

Table (5): Number and frequency distribution of different types of ovarian cycle of heifers in different treatment groups from puberty to conception.

Dietary treatment group		n	Type of ovarian cycle					
			Short (<17 d)		Normal (18-24 d)		Long (>24 d)	
Feeding level	Supplement		n	%	n	%	n	%
100%	Without	44	6	13.6	30	68.2	8	18.2
	DBY	37	4	10.8	27	72.9	6	16.3
80%	Without	48	3	6.30	29	60.4	16	33.3
	DBY	38	5	13.2	32	84.2	1	2.60
120%	Without	32	2	6.20	26	81.3	4	12.5
	DBY	29	-	-	24	82.7	5	17.3

N: Total number of ovarian cycles.

Progesterone profile:

Data in Table (6) shown during pre-puberty stage, Pg concentration was affected significantly ($P<0.05$) by dietary treatment. Concentration of Pg significantly ($P<0.05$) decreased by decreasing feeding level from 100 to 80%, and significantly ($P<0.05$) increased by DBY supplementation with 80% level. However, Pg concentration was not affected by increasing feeding level from 100 to 120% or DBY supplementation with 100 or 120% feeding level.

Table (6): Progesterone concentration (ng/ml) of heifers in blood plasma of different treatment groups at pre-pubertal stage, 1st service and early pregnancy.

Stage	Dietary treatment group					
	100%		80%		120%	
	Without	DBY	Without	DBY	Without	DBY
Pre-puberty	1.37±0.19^a	1.60±0.06^a	0.69±0.04^b	1.26±0.16^a	1.34±0.06^a	1.18±0.26^a
At 1st service	0.70±0.09	0.56±0.14	0.30±0.04	0.65±0.09	0.73±0.26	0.34±0.05
E. pregnancy	1.84±0.38	2.94±0.48	1.63±0.31	3.16±0.92	2.22±0.75	1.62±0.21

a and b: Group means denoted with different superscripts are significantly different at ($P<0.05$).

At 1st oestrus and early pregnancy stage, Pg concentration was not affected significantly by treatment group or DBY supplementation, ranging between 0.3 and 0.7 ng/ml at 1st service and

between 1.63 and 3.15 ng/ml at early pregnancy stage (Table 6). It is of interest to not that the low level of Pg at 1st oestrus, being almost less than 1 ng/ml indicated the incidence of oestrus/ovulation in all heifers at the time of insemination. Also, the high Pg level at early pregnancy stage, being more than 1 ng/ml indicated the incidence of pregnancy in pregnant heifers as mentioned by rectal palpation on day 60 post-insemination. Similar results were obtained on buffalo heifers by **Abdel-Latif (2005)**, who found insignificant differences in average concentration of Pg prior to puberty.

In agreement with the present results, **Lammoglia *et al.* (2000)** found that high-energy diet affected progesterone ($P<0.05$) concentration.

Conception rate (CR) and number of service/conception (NS/C):

Results in Table (7) reveal that decreasing feeding level from 100 to 80%, significantly ($P<0.05$) decreased CR from 66.7 to 33.3%, but did not affect NS/C, being 2.0 services/conception for both feeding levels. However, increasing feeding level from 100 to 120% significantly ($P<0.05$) increased CR to 83.3% and significantly ($P<0.05$) decreased NS/C from 2.0 to 1.4 (Table 7). On the other hand, DBY supplementation significantly ($P<0.05$) increased CR for all feeding levels, from 66.7 to 83.3% for 100% feeding level, from 33.3 to 50.0% for 80% feeding level and from 83.3 to 100% for 120% feeding level. However, DBY supplementation showed conflicted effects on NS/C, being positive for 100% feeding level (1.4 vs. 2.0) and negative for 80% feeding level (2.0 vs. 3.3) and 120% feeding level (1.4 vs. 2.17, Table 7).

Table (7): Number of services/conception and conception rate (%) of heifers in different treatment groups after four services.

Item	Dietary treatment group					
	100%		80%		120%	
	Without	DBY	Without	DBY	Without	DBY
Number of services/conception	2.0 ± 0.3^{b}	1.4 ± 0.3^{c}	2.0 ± 0.3^{b}	3.3 ± 0.3^{a}	1.4 ± 0.3^{c}	2.17 ± 0.1^{b}
Conception rate (%):						
1st service	33.3	33.3	16.6	-	66.6	33.3
2nd service	33.3	50	-	16.6	16.6	33.3
3rd service	-	-	16.6	-	-	16.6
4th service	-	-	-	33.3	-	16.6
Total	**66.7^{c}**	**83.3^{b}**	**33.3^{d}**	**50.0^{cd}**	**83.3^{b}**	**100^{a}**

A, b....d: Group means denoted with different superscripts are significantly different at ($P<0.05$).

The obtained results indicated the beneficial effect of DBY on improving CR of heifers fed 100% feeding level as found by increasing feeding level from 100 to 120%, whereas heifers in both groups showed similar CR (83.3%) and NS/C (1.4). This also indicated the effect of dietary energy level on CR of heifers. The improving CR in 120 feeding level may be in relation to LBW. **Gaafar *et al.* (2005)** reported that conception rate increased with increasing LBW category of Friesian heifers. However, **Baptiste *et al.* (2005)** observed that conception rate was not affected significantly by dietary level of yearling beef heifers (Angus, Hereford, and Angus x Hereford). The present results are similar to that obtained on Egyptian buffalo heifers fed YC diet as compared to control heifers **(Abdel-Latif, 2005)** or on Friesian heifers fed DBY diet **(Ghorab, 2007)**. Also, **Ibrahim (2004)** found that yeast culture supplementation resulted in significant reduction in NS/C of Egyptian buffalo cows.

CONCLUION

In conclusion, feeding Friesian heifers during pre-puberty on levels 100 and 120% with DBY improved puberty and reproductive performance in term of shortening age of puberty and 1st service, SP, NS/C and increased conception rate in Friesian heifers.

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الملخص العربي

تأثير مستوى التغذية مع أو بدون إضافة الخميرة علي خصائص البلوغ في العجلات الفريزيان.

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أجريت هذه الدراسة في محطة بحوث الإنتاج الحيواني بسخا-التابعة لمعهد بحوث الإنتاج الحيواني – مركز البحوث الزراعية – وزارة الزراعة بالتعاون مع قسم الإنتاج الحيواني – كلية الزراعة جامعة الأزهر خلال الفترة من يوليو ٢٠٠٤ حتى أكتوبر ٢٠٠٦. استخدمت في هذه الدراسة ٣٦ عجلة فريزيان عند متوسط عمر ١٠,٤٧ شهر متوسط وزن جسم الحي ١٧٥,٦ كجم – قسمت إلى ثلاثة مجاميع متشابهة في الوزن والعمر. غذيت على ثلاثة مستويات غذائية مختلفة ٨٠ و١٠٠ و١٢٠% من أحتياجات NRC (١٢ عجلة في كل مستوي) و تحت كل مستوى غذائى مجموعتين المجموعة الاولى بدون والثانية مضاف لها خميرة الخباز الجافة بمعدل ١٠ جرام لكل راس فى اليوم و تهدف هذه الدراسة الى معرفة تاثير المستويات الغذائية المختلفة مع او بدون الخميرة على عمر و وزن البلوغ و كذلك الكفاءة التناسلية لعجلات الفريزيان وكانت النتائج المتحصل عليها كالتالى :

- لم يتأثر الوزن عند أول شياع (البلوغ) في جميع المجموعات معنويا، أما العمر فكان اقل معنويا في العجلات المغذاة على ١٢٠ % مع أو بدون خميرة مقارنة بباقي المجموعات.

- لم يتأثر الوزن عند أول تلقيحه في جميع المجموعات معنويا، بينما نقص العمر معنويا في العجلات المغذاة على ١٢٠ % مع أو بدون خميرة (٥٦ و ٧٣ يوم على الترتيب) مقارنة بباقي المجموعات.
- النشاط المبيضى كان متشابه في كل المجموعات بينما كان طول دورة الشياع أقصر بدون فروق معنوية في العجلات المغذاة على ١٢٠ % مع أو بدون خميرة مقارنة بباقي المجموعات.
- أنخفض تركيز هرمون البروجسترون في البلازما معنويا في جميع العجلات في فترة ما قبل البلوغ بنقص مستوى التغذية من ١٠٠ إلى ٨٠ %. و أدت إضافة الخميرة إلى زيادة مستوى البروجسترون معنويا في العجلات المغذاة على مستوى ٨٠ % فقط. بينما لم يتأثر مستوى البروجسترون عند التلقيح الأول أو الحمل المبكر معنويا في كل المجاميع بمستوى التغذية أو إضافة الخميرة.
- أدت إضافة الخميرة إلى تحسين معدل الإخصاب في العجلات المغذاة في كل المجاميع وكذلك انخفض عدد التلقيحات اللازمة للحمل.

وتوصى هذه الدراسة بأن تغذية العجلات الفريزيان علي مستوى ١٠٠ و ١٢٠% من مقررات NRC حسنت الأداء التناسلى وقصرت عمر البلوغ وأدت إلي زيادة معدل الإخصاب.