Effect of Interleukin -6 Level on Reproductive Performance in Holstein Cows

Suaad Shnawa Jassim and Hamza Mizail Hawa

Faculty of Agriculture/ University of Kufa/ Republic of Iraq

Corresponding author Email: suaadjassim1@gmail.com

DOI: https://doi.org/10.36077/kjas/2023/v15i2.3860

Received: 1/7/2022

Accepted: 16/7/2022

Abstract:

The current study was conducted in a private dairy cow's station located in the middle of Iraq by using 80 samples of blood during the period 2021 – 2022 in the aim to determine the effect of Interleukin-6 (IL-6) concentration on reproductive performance. Results showed a significant effect (P≤0.05) of IL-6 level on reproductive parameters. Days open differed significantly according to this interleukin and the highest days open was recorded in cows with low IL-6 level namely, 187.37 pg/ml. Service per conception differed significantly according to IL-6 level in blood plasma, the highest number of services per conception was recorded in cows with low IL-6 interleukin about 3.77 service. Calving interval differed significantly according to IL-6 concentration, the longest period was noticed in cows with low IL-6 level compared with the shortest period which was noticed in cows with moderate IL-6 level namely, 482.48 and 400.25 day respectively. Ovulation weakness differ significantly (P≤0.05) according to IL-6, the highest rate of infection was recorded in cows with high IL-6 level (63.64%) from total number about 33 cases while the lowest rate of ovulation weakness was noticed in cows with low IL-6 level namely, 21.21%.

Keywords: Holstein cows, Reproductive performance, Interlukin-6**.**

Introduction:

The host immunity is divided classically in to two divisions, innate and adaptive immunity. The 1st type is reacted unlimitedly with diseases pathogens while the 2nd type is response slowly but in limited direction to these pathogens (9). Studies referred that the innate immunity react through the natural cells killing and innate lymph cells also while the adaptive immunity represented to the multiple types of globulins and lymph cells such as T and B cells (2 and 5).

Reproductive immunity means the recognition and remove the strange substances (microbial organs or its products) inside the reproductive system and lead to fertility problems in mammals (18).

The female reproductive system is many organs which immunologically officinal to different reactions towards inflammation, embryo accepting, development of fetus, tissues formation and then complete parturition successfully (1 and 15).

Cytokines are a wide group of compounds which play a crucial role in reproductive efficiency of females and the interleukins are cytokines sub group which produce many compounds to enhance the fetus growth and development (10 and 12).

Interleukin -6 (IL-6) is essential member of the interleukin's family, contains 212 amino acid with 21 – 26 Kd as a molecular weight (8). IL-6 can behave as autocrine or paracrine ligand in body muscles and also behave as a hormone during metabolism. In addition, IL-6 enhance the insulin function and control of many other interleukins releasing such as IL-1, IL-10 (4 and 14).

The major aim of the current study is to investigate about the IL-6 role in reproductive performance in Iraqi Holstein cows and attempt to use the information as a prediction tool for possible changes in reproduction depending on IL-concentrations to avoid any reproductive problems or difficulties and decrease the risk of economic loss.

Materials and Methods:

The current study was conducted in Taj – AL-Nahrain private station located in AL-Daggara about 20 Km north east of AL-Dewanya province center by using 80 samples of blood during the period 2021 – 2022.

Blood samples were withdrawn from uterine vein through milking and ELISA test was used to determine the IL-6 concentration from each cow. The cows were divided in to three groups according to the IL-6 concentration (low, moderate and high).

Statistical analysis**:** Data were analyzed using SAS (13) computer program by general linear model procedure (GLM) according to the following model:

$Y_{ijk} = \mu + T_i + e_{ijk}$

Where: μ: the overall mean

T_i: effect of IL-6 interlukin

e_{ijk}: is a random error.

Significant differences among groups were detected by general linear model (GLM) and Duncan's multiple range test

(Duncan)(6) was used to compare differences among means.

Chi- square test was used to determine the significant differences among reproductive problems rates:

$$X^2 = \sum \frac{(Observed\ No. - Expected\ No.)^2}{Expected\ No.}$$

Results and discussion:

Results showed a significant effect (P≤0.01) of IL-6 level on reproductive traits parameters (Table1), Days open differed significantly according this interleukin and the highest days open was recorded in cows with low IL-6 level namely, 187.37 pg/ml while the shortest day open period was recorded in cows with moderate IL-6 level namely, 164.12 pg.ml^{-1}.

Table 1. Effect of IL-6 on reproductive traits in Holstein cows

Il-6 pg. ml^{-1}	Reproductive traits D.O	S.C	C.I
Low <400	187.37 ± 5.6 a	3.77 ± 0.52 a	482.48 ± 15.7 a
Moderate 400 -500	164.12 ± 3.5 b	1.09 ± 0.11 c	400.25± 13.3 b
High > 500	167.17 ± 4.6 b	2.12 ± 0.54 b	432.17 ± 11.8 c
Significance	**	**	**

D.O: day open, S.C: service per conception, C.I: calving interval. **: P≤0.01

Service per conception differed significantly according to IL-6 level in blood plasma, the highest number of services per conception was recorded in cows with low IL-6 interleukin about 3.77 service while the lowest number was in cows with moderate IL-6 level namely, 1.09 service.

The results showed that the calving interval differed significantly according to IL-6 concentration, the longest period was noticed in cows with low IL-6 level compared with the shortest period which noticed in cows with moderate IL-6 level namely, 482.48 and 400.25 day respectively.

Results showed an appearance of reproductive problems in samples that studded, retained placenta rate was differed according to IL-6 level (Table 2), the total number of caws which suffer from retained placenta was 34 and the number of cases in cows with low IL-6 concentration was 8 (23.53%) while the highest number was in cows with high IL-6 level namely, 16 (47.06%).

Ovulation weakness differ significantly (P≤0.01) according to IL-6, the highest rate of infection was recorded in cows with high IL-6 level (63.64%) from total number about 33 cases while the lowest rate of ovulation weakness was noticed in cows with low IL-6 level namely, 21.21%.

Results showed that the total number of fetus mortality was7 cases and theoretically differed according to the IL-6 concentration, the highest fetus mortality was recorded in cows with high or moderate IL-6 level (3 cases) while the rate of fetus mortality was 1 case (14.29) in cows with low concentration of IL-6.

Table 2. Effect of IL-6 on reproductive problems in Holstein cows

Il-6 pg.ml^{-1}	Reproductive problems No. (%)		
	R.P	O.W	F.M
Low	8 (23.53)	5(15.15)	1(14.29)
Moderate	10 (29.41)	7(21.21)	3(42.86)
High	16 (47.06)	21(63.64)	3(42.86)
Chi-square	3.0932	13.9611**	1.1551
Total (%)	34 (100%)	33(100%)	7(100%)

R.P: retained placenta, O.V: ovulation weakness, F.M: fetus mortality, **: P≤0.01

The current results are agreed with many past researches results that mentioned effect of L-6 or other similar interleukins on reproductive performance in dairy cattle such as Trevisi *et al*. (16) who mentioned that the alterations of interleukins levels are strongly difficulties with reproductive traits or reproductive difficulties. Chastant and Saint-Dizier(3) indicated that the increase of interleukins during artificial insemination led to reduce the fertility and increase the probability of pregnancy failure.

Other studies proved a relationship of interleukins concentration with many reproductive parameters in cattle such as days open, gestation length, calving intervals and service per conception (7, 11 and 17). In conclusion, the current results are a good tool to determine the possible effect of interleukin -6 on reproductive performance and we can predict the reproductive difficulties through the concentration of this interleukin to improve the cow performance and avoid the reproductive difficulties earlier.

Conflict of Interest

The authors have no conflict of interest**.**

Reference:

1- **Ault, T.B., B. A. Clemmons, S.T. Reese, F.G. Dantas, Franco G.A. and Smith, T.P.L. 2019.**Uterine and vaginal bacterial community diversity prior to artificial insemination between pregnant and nonpregnant postpartum cows. J. Anim. Sci., 97(10): 4298–4304. doi: 10.1093/jas/skz210.

2- **Boehm, T.; N. McCurley; Y. Sutoh; M. Schorpp; M. Kasahara and Cooper, M.D.2012.** VLR-based adaptive immunity. Annu. Rev. Immunol., 30: 203–220.

3- **Chastant S. and M. Saint-Dizier. 2019.** Inflammation: friend or foe of bovine reproduction? Anim. Reprod.,16(3): 539-547. doi: 10.21451/1984-3143-AR2019-0057.

4- **Catoire, M. and S. Kersten S. 2015.**The search for exercise factors in humans. FASEB J., 29: 1615–1628. https://doi.org/10.1096/fj.14-263699.

5- **Danilova, N. 2012.**The evolution of adaptive immunity. Adv. Exp. Med. Biol., 738: 218–235. doi: 10.1007/978-1-4614-1680-7_13.

6- **Duncan, D.B. 1955.** Multiple Range and Multiple F Tests. Biometrics, 11 :1- 41.

7- **Ealy, A. D., S. Speckhart and Lydia K. 2021.**Wooldridge Cytokines That Serve as Embryokines in Cattle.

Animals 2021, 11, 2313. https://doi.org/10.3390/ani11082313.

8- **Evans, S. S.; E. A. Repasky and Fisher, D.T. 2015.** Fever and the thermal regulation of immunity: the immune system feels the heat. Nat. Rev. Immunol., 15: 335–349.

9- **Farber, D. L., M. G. Netea, A. Radbruch, K. Rajewsky and Zinkernagel, R.M. 2016**. Immunological memory: lessons from the past and a look to the future. Nat. Rev. Immunol., 16:124-128.

10- **Gulati, K., S. Guhathakurta, J. Joshi, N. Rai and Ray, A. 2016.** Cytokines and their role in health and disease: a brief overview. MOJ Immunol., 4(2): 1-9.

11- **Ishikawa, Y., Nakada, K. Hagiwara, R. Kirisawa, H. Iwai; M. Moriyoshi and Sawamukai Y. 2004.** Changes in interleukin-6 concentration in peripheral blood of pre- and post-partum dairy cattle and its relationship to postpartum reproductive diseases. J. Vet. Med. Sci. 66(11):1403-1408. doi: 10.1292/jvms.66.1403.

12- **Menachem-Zidon, O.B., A. Avital, Y. Ben-Menahem, I. Goshen, T. Kreisel, E.M. Shmueli and Yirmiya, R. 2011.** Astrocytes support hippocampal-dependent memory and long-term potentiation via interleukin-1 signaling. Brain Behav. Immun., 25(5): 1008-1016.

13- **SAS. 2012.** Statistical Analysis System, User's Guide. Statistical. Version 9. 1th ed. SAS. Inst. Inc. Cary. N.C. USA.

14- **Scheller, J., A. Chalaris, D. Schmidt-Arras and Rose-John, S. 2011.** The pro- and anti-inflammatory properties of the cytokine interleukin-6. BiochimBiophys. Acta. 1813(5): 878–888. doi: 10.1016/j.bbamcr.2011.01.034.

15- **Schuberth, H. J., U. Taylor, H. Zerbe, D. Waberski, R. Hunter and Rath, D. 2008**.Immunological responses to semen in the female genital tract. Theriogenology., 70: 1174–1181. doi: 10.1016/j.theriogenology.2008.07.020.

16- **Trevisi, E, G. Bertoni, A. Ferrari and Menuti A. 2016.** Pro-Inflammatory Cytokine Profile in Dairy Cows: Consequences for New Lactation. https:// doi.org/ 10.4081/ ijas. .3862.

17- **Xie, M., S.R. McCoski, S.E. Johnson, M.L. Rhoads and Ealy, A.D. 2017.**Combinatorial effects of epidermal growth factor, fibroblast growth factor 2 and insulin-like growth factor 1 on trophoblast cell proliferation and embryogenesis in cattle. Reprod. Fertil. Dev., 29: 419-430. doi: 10.1071/RD15226.

18- **Weiss, G., L.T. Goldsmith, R.N. Taylor, D. Bellet and Taylor, H.S. 2009.** Inflammation in reproductive disorders. Reprod. Sci., 16:216– 229. doi: 10.1177/1933719108330087.