Short Communication

RELATIVE RESPONSE OF PREGNANT SOW WITH PARENTERAL SUPPLEMENTATION OF IRON ON HEMATOLOGICAL VARIABLES AND OCCURRENCE OF STILLBIRTH

P. Thirunavukkarasu[1]*, S. Ramakrishnan[2], R. Sakthivadivu[3], C. Nithya[4] and M. Sathiyabarathi[5]

Livestock Farm Complex,
Veterinary College and Research Institute,
Tamil Nadu Veterinary and Animal Sciences University
Namakkal - 637 002.

ABSTRACT

A study was carried out in pregnant sows with iron supplementation to assess the hematological variables as well as prevalence of stillbirth condition in the litter. A total of 12 pregnant sows of Large White Yorkshire were selected and divided into two groups under this study. Blood samples were collected at three different intervals during pregnancy and after farrowing. The first blood collection was carried out before administering iron injection and parentral iron supplementation (2000 mg intramuscularly) was done at 15 days interval. The second collection of blood was done after treatment just before farrowing. The third collection of blood was done at three weeks immediately after farrowing and the samples were analyzed by using auto analyser. The occurrence of stillbirth and total number of live piglets born were calculated during the farrowing. The variability in hematologic parameter and still birth condition of sows were analyzed by standard statistical method. The average value of heme protein concentration in sow was 11.52 gm /dl prior to farrowing. The litter size of 9.83 (0.87) and 0.33 (0.21) were achieved with respective of piglets born and stillborn piglets in iron supplemented group. Though the occurrence of still born condition between treated and control group did not differ significantly but had significant effect on total born piglets between groups.

Keywords: : Swine, hemoglobin, stillbirth, total piglets born, iron supplementation

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INTRODUCTION

The incidence of stillbirth plays a crucial role in controlling the litter size of highly prolific sows, presenting a significant economic and welfare challenge in large litters within porcine production (Pig CHAMP, 2016). The prevalence of stillbirth among piglets has exhibited a notable increase in Denmark (Hansen, 2018) and globally, largely attributed to the selective breeding of sows for increased prolificacy.

Hematological variables in blood profiles contribute to the mitigation of

[1]Assistant Professor,
* Corresponding author Email id: karasudr@gmail.com
[2]Professor and Head
[3]Assistant Professor
[4]Assistant Professor
[5]Assistant Professor

stillbirth occurrences in the litter. The manifestation of anaemic conditions is linked to a diminished concentration of heme protein (HbC) in the blood of sows (Madsen, 1996), thereby presenting a significant risk factor for stillbirths (Moore *et al.* 1965). Iron, a vital element, assumes paramount importance in the synthesis and organization of heme proteins (Hb). These proteins rapidly nourish during the advanced gestation period in sows, serving as a crucial source of iron for the developing fetuses (Madsen, 1996), consequently leading to a subsequent reduction in the occurrence of stillborn piglets. Therefore, an experiment was conducted in pregnant sows to study the relative response of iron supplementation on the litter size and also to study the occurrence of stillbirth in pregnant sows. This investigation can contribute to crucial insights into the management practices of sows during mid-gestation, offering potential applications for optimizing sow health and reproductive outcomes.

MATERIAL AND METHODS

This study was carried out in 12 mid-gestation sows at Livestock Farm Complex, Veterinary College and Research Institute, Namakkal, Tamil Nadu. The animals were divided into two homogenous groups with equally dividing into 7,6,3 and first parity. The trial was conducted from June to September, 2022 and all the animals were maintained under standard managemental practices for pregnant sows.

Parenteral supplementation

In the experimental protocol, the treatment group of sows received intramuscular supplementation of 2000 mg iron (Bhattarai *et al.,* 2019b) in the form of iron dextran injection (Ferritas®) during 56-69 days of gestation. This was administered as a split dose of 20 ml on each side of the neck region. A second dose was administered similarly to both groups between 70 and 84 days of gestation.

Sample collection

Blood sample was collected thrice at defined intervals. The first sampling was done before iron supplementation at gestational days 56-69 to establish the baseline data. The second sampling took place within the three weeks preceding farrowing, capturing the pre-parturition context. The third sampling was done between 19 and 36 days post-farrowing, providing insights into postpartum hematological dynamics.

Blood samples were collected from ear vein using a 20 G x 1 inch needle and collected in EDTA tubes. The hematological variables investigated includes Hb count, red blood cell count (RBC), hematocrit (HCT), mean corpuscular cell volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red blood cell distribution width (RDW) and hemoglobin distribution width (HDW). These parameters were analyzed on the day of collection using an automated hematology analyzer.

Prevalence of stillbirth condition

A stillborn piglet is defined as one lacking lung inflation by external air. Live-born piglets and the overall farrowing count were meticulously documented. In addition to these parameters, factors such as gestational age, expected farrowing date, the quantity of stillborn, live-born piglets, mummified piglets and the total number of piglets born were also recorded. This comprehensive approach ensured a thorough examination of various aspects related to piglet viability and reproductive outcomes.

Analysis of statistical data

The data that were collected during this trial were analysed using oneway ANOVA.

RESULTS AND DISCUSSION

Hematological changes in sows

Hematological variables between control and treatment group of sows are illustrated in Table 1(Prior to treatment, post-treatment, and 3 weeks after farrowing). The values of sows hematological variables were compared with normal ranges showed no significant differences. Sows showed a remarkable variation ($p < 0.01$) in white blood cell count and MID (mean cell distribution width) prior and subsequent to the farrowing. This variation is due to involution of uterus or acquired immunity against post parturient infections which is suggestive of an adaptive physiological response.

The blood parameter variables like Hb count and other hematological values exhibited no remarkable difference although it contributes to the overall health status of the sows.

The mean hemoglobin concentration in sows ranged from 10.52 to 11.52 g / dl during gestation and post-farrowing period indicative of potential iron transfer dynamics. The lowest concentration (10.52 g / dl) indicates maternal iron reserve and its contribution to piglets. Maternal source of iron influences the iron demand of the young developing fetus significantly (Buhi *et al,* 1982), with altered Hb count further influenced by age, physiological status, sample size, breed, management practices and laboratory techniques (Bhattarai *et al,* 2018).

Prevalence of stillbirth

The stillbirth condition of piglets in the treatment groups (0.33 ± 0.21) was reduced in comparison to the control group (1.17 ± 0.65), even though there is no significant difference, a comparable variation was observed in treated sows.

Hematological variations and prevalence of stillbirth condition resulted from reduced oxygen supply to piglets while passing through the vaginal canal which was exacerbated by low iron status of the sow (Bhattarai *et al.,* 2019). The other possibility of stillbirth was due to hypoxia that would have been precipitated by large litter size and longer farrowing interval, ultimately leading to placental detachment or umbilical cord rupture leading to subsequent stillbirths (Lucia *et al,* 2022; Canario *et al,* 2006).

The occurrence of stillbirth conditions in sows is highly associated with an elevation in Hb count, according to Bhattarai *et al.* (2018), which decreases the blood volume as it increases from mid-gestation until farrowing. The duration of farrowing, sow health status and piglet birth order will also contribute to stillbirth occurrences, as highlighted by Borges *et al.,* (2005). Uterine inertia as outlined by Bhattarai *et al*.. (2019). In large litter size and variability among littermates contribute, as elucidated by Wolf *et al.,* (2008).

CONCLUSION

This study concluded an inverse relationship with the incidence of stillbirth and Hb count, which might be indicative of physiological sow performance. Correlations exist between stillbirth occurrences, sow hematological values, oxygen availability during farrowing and iron deficiency. Elevated hemoprofile positively correlate with efficient endometrial contraction, potentially reducing stillborn prevalence.

Erythrocyte indices, including Hb count, MCH, MCHC, RDW, RDWCV and RDWSD, show a positive correlation with incidence of stillbirth and hematological variables before piglet delivery. Although there is no marked change in stillbirth prevalence, a comparable increase in piglet number per litter benefits farmers by enhancing overall productivity in pig breeding operations.

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Conflict of interest

The authors declare that there is no conflict of interest.

Table 1. Mean values of hematological parameters in pigs (±S.E.)

Parameter studied	Prior to treatment		3 weeks preceding farrowing After treatment		3 weeks after farrowing		Normal range value
	Control	Treatment	Control	Treatment	Control	Treatment	
WBC, 10^3/ul	15.48 ± 0.75^{AB}	13.96 ± 0.77^{A}	14.57 ± 0.76^{A}	19.99 ± 2.27^{AB}	21.05 ± 2.55^{BC}	24.39 ± 3.32^{C}	11 - 22
Lymphocyte,10^3/ul	5.04 ± 1.22	6.86 ± 0.37	5.56 ± 0.27	5.73 ± 0.53	5.04 ± 0.51	5.22 ± 0.39	3.5 - 7.5
MID, 10^3/ul	0.89 ± 0.05^{AB}	0.73 ± 0.04^{A}	0.75 ± 0.05^{AB}	0.98 ± 0.09^{BC}	0.97 ± 0.13^{ABC}	1.13 ± 0.08^{C}	0.2 - 1.0
Granulocyte, 10 ^3/ul	9.74 ± 0.73^{ABC}	6.38 ± 0.48^{A}	8.22 ± 0.92^{AB}	13.32 ± 2.35^{BCD}	15.00 ± 2.06^{CD}	17.88 ± 3.39^{D}	2.8 - 4.7
Lymphocyte %	30.65 ± 7.02	49.42 ± 1.78	39.05 ± 3.29	30.49 ± 5.63	24.25 ± 1.75	23.67 ± 4.11	35 - 75
MID %	5.64 ± 0.31	5.12 ± 0.10	5.17 ± 0.46	4.90 ± 0.65	4.53 ± 0.22	4.87 ± 0.43	2 - 10
Granulocyte %	63.52 ± 6.78^{b}	45.49 ± 1.87^{a}	55.97 ± 3.63^{ab}	65.00 ± 5.76^{b}	71.22 ± 1.84^{b}	71.50 ± 4.45^{b}	28 - 47
RBC, 10 ^6 / ul	6.085 ± 0.19	5.92 ± 0.28	5.72 ± 0.182	5.72 ± 0.15	5.68 ± 0.19	5.44 ± 0.11	5 - 8
Haemoglobin, gm/ dl	11.52 ± 0.29	11.27 ± 0.46	11.15 ± 0.24	11.07 ± 0.14	11.10 ± 0.34	10.52 ± 0.06	10 - 16
MCHC, gm/ dl	27.77 ± 0.28	28.23 ± 0.60	27.48 ± 0.19	27.50 ± 0.22	27.42 ± 0.27	27.37 ± 0.33	30.3 - 34.0
MCH, pg	19.50 ± 0.56	19.13 ± 0.14	19.37 ± 0.40	19.33 ± 0.30	19.63 ± 0.31	19.35 ± 0.26	17 - 21
MCV, fL	68.82 ± 2.01	68.27 ± 1.52	70.72 ± 1.44	70.53 ± 1.36	71.65 ± 1.70	70.85 ± 1.34	50 - 68
RDWCV, %	13.75 ± 0.23	13.76 ± 0.13	13.65 ± 0.09	13.82 ± 0.07	13.64 ± 0.19	13.65 ± 0.06	14 - 19
RDWSD, fL	44.97 ± 1.10	44.23 ± 0.82	45.12 ± 0.91	45.68 ± 0.82	45.48 ± 0.99	45.42± 0.91	35 - 56
HCT, %	41.43 ± 1.13	40.34 ± 1.37	40.62 ± 0.60	40.25 ± 0.31	40.55 ± 1.31	38.47 ± 0.63	32 - 50
PLT, 10 ^3/ul	423.00 ± 90.54	477.50 ± 113.19	312.83 ± 27.82	354.00 ± 53.82	507.50 ± 47.26	389.83 ± 37.57	320 - 520
MPV, fL	7.48 ± 0.52	7.60 ± 0.60	8.22 ± 0.16	8.77 ± 0.14	8.32 ± 0.41	8.17 ± 0.24	6 - 12
PDW , fL	14.73 ± 1.58	13.60 ± 1.84	17.30 ± 0.20	17.45 ± 1.08	14.73 ± 0.54	14.47 ± 0.58	10 - 18
PCT, %	0.30 ± 0.04	0.35 ± 0.07	0.26 ± 0.03	0.31 ± 0.05	0.42 ± 0.05	0.32 ± 0.04	0.1 - 0.5
P-LCR , %	15.60 ± 4.06	24.38 ± 2.26	18.78 ± 3.17	23.58 ± 1.30	19.98 ± 1.56	18.93 ± 1.05	13 - 43

Means bearing different superscripts between rows (a,b) differ significantly ($P<0.05$)
Means bearing different superscripts between rows (A, B,C, D) differ significantly ($P<0.01$)

HCT - Hematocrit,
PLT - Platelet count,
MPV - Mean Platelet volume,
PDW - Platelet Distribution width,
PCT – Platelet cell volume
P-LCR - Platelet cell ratio
MID - Combined value of the other types of white blood cells not classified as lymphocytes or granulocytes
RDWCV - Red cell distribution width – Coefficient of variation
RDWSD - Red cell distribution width – Standard deviation

Table 2.Effect of parenteral route of iron injection on piglets born and incidence of stillbirth

Parameters	Control	Treatment
Piglets born	9.33 ± 1.87[a]	9.83 ± 0.87 [b]
Piglets birth weight	1.13 ± 0.01	1.38 ± 0.01
Still birth	1.17 ± 0.65	0.33 ± 0.21

REFERENCES

Bhattarai, S., Framstad, T. and Nielsen, J. P. (2018). Stillbirths in relation to sow hematological parameters at farrowing: a cohort study. *Journal of Swine Health Production,* **26**:215-222.https://www.aasv.org/shap/issues/v26n4/v26n4p215.html.

Bhattarai, S., Framstad, T. and Nielsen, J.P. (2019). Association between sow and piglet blood haemoglobin concentrations and stillbirth risk. *Acta Veterinaria Scandinavica*, **61**: 61. https://doi.org/10.1186/S13028-019-0496-7.

Bhattarai, S., Framstad, T. and Nielsen, J.P. (2019b). Iron treatment of pregnant sows in a Danish herd without iron deficiency anemia did not improve sow and piglet hematology or stillbirth rate. *Acta Veterinaria Scandinavica*, **61**:60. https://doi.org/10.1186/S13028-019-0497-6.

Borges, V.F., Bernardi, M.L., Bortolozzo, F.P. and Wentz, I. (2005). Risk factors for stillbirth and foetal mummification in four Brazilian swine herds. *Preventive Veterinary Medicine*, **70**(3):165-176.https://doi.org/10.1016/j.prevetmed.2005.03.003.

Buhi, W.C., Ducsay, C, Bazer, F. and Roberts, R. (1982). Iron transfer between the purple phosphatase uteroferrin and transferrin and its possible role in iron metabolism of the fetal pig. *Journal of Biological Chemistry*, **257**: 1712 - 23.https://doi.org/10.1016/S0021-9258(19)68096-8.

Canario, L., Cantoni, E, Le Bihan, E, Caritez, J.C, Billon, Y, Bidanel, J.P. and Foulley J.L. (2006). Between- breed variability of stillbirth and its relationship with sow and piglet characteristics. *Journal of Animal Science*,**84**(12): 3185 -3196. https://doi.org/10.2527/jas.2005-775.

Hansen, C, 2018. National average productivity in pig production in 2017 (https://pigresearchcentre.dk/-/media/PDF/English-site/english-pdf/1819/Notat_1819_UK_CHA.pdfAccessed May 2024)

Lucia, Jr, T., Correa, M.N, Deschamps, J.C, Bianchi, I, Donin, M.A, Machado, A.C, Meincke, W. and Matheus, J.E.

(2022). Risk factors for stillbirths in two swine farms in the south of Brazil. *Preventive Veterinary Medicine,* **53**(4):285-292.https://doi.org/10.1016/s0167-5877(01)00288-4.

Madsen, M.T. (1996). Iron deficiency (anemia)in Danish sows. https://ouci.dntb.gov.ua/en/works/96OqpKB7/ Accessed May 2024.

Moore, R., Redmond, H. and Living-Ston, C. Jr. (1965). Iron deficiency anemia as a cause of stillbirths in swine. *Journal of American Veterinary Medical Association,* **147**: 746 - 748. https://patents.google.com/patent/EP3212182A1/en.

PigCHAMP. (2016). Benchmarking Summaries. http://www.Pigchamp.com/benchmarking/bench-marking-summaries. Published 2017. Accessed May, 2024.

Wolf, J., Zakova, E. and Groeneveld, E. (2008). Within-litter variation of birth weight in hyperprolific Czech Large White sows and its relation to litter size traits, stillborn piglets and losses until weaning. *Livestock Science*, **115**(2-3):195-205.https://doi.org/10.1016/j.livsci.2007.07.009