B-5091
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RESEARCH ARTICLE Indian Journal of Animal Research

Effect of Feeding Milk Replacer on Growth Performance and Stress Physiology of Ghoongroo Piglets in Tropical Climate

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10.18805/IJAR.B-5091

ABSTRACT

Background: The pig is the most efficient feed-converting animal among all livestock and plays a crucial role in improving the socioeconomic status of rural masses. of India. The present study was to develop a best-suited milk replacer for piglets and its effect on growth performance and stress physiology of Ghoongroo piglets.

Methods: The experiment was conducted on 20 Ghoongroo piglets divided into four groups, each containing 5 piglets, *i.e.*, 3 treatment groups and 1 control group maintained at Livestock Farm ERS-IVRI, Kalyani. Control group (T0) piglets kept with sows and looked after under standard management practices. Whereas, three treatment groups (T1, T2 and T3) piglets were fortified with 3 different kinds of milk replacers and piglets were fed through bottle feeding for 28 days, thereafter, creep feed was started and gradually, milk replacer was stopped.

Result: Significant difference (P<0.05) was observed in average body weight (kg) and daily body weight gain (g/day) on 56 days of age between the treatment and control groups. It was also found that feeding milk replacers had no stress on piglets. So, it can be concluded that feeding milk replacers showed improved economic return along with a higher growth rate till weaning without any stress on the piglets.

Key words: Ghoongroo pig, Milk replacer, Piglets.

INTRODUCTION

Pig farming is one of the most lucrative ventures and back bone of economy among the tribal communes of India and one of the employment pathways of educated unemployed youth in eastern part of India irrespective of societal status. There are many constraints in sustainability and economic feasibility of pig farming among which pre-weaning mortality of a farm is the prime cause of concern. Low birth weight of litter as well as low milk production and poor health condition sow also enhances the pre-weaning mortality. Sometimes disease like MMA may also lead to sudden cessation of milk production which may increase the mortality rate.

Moreover, less milk production reduces average litter weight at weaning. Weaning weight is correlated to birth weight and to the volume of sow's milk which was consumed by piglets during lactation (Wolter and Ellis, 2001). Weaning weight of suckling pigs is associated with post-weaning growth rate (Klindt, 2003). To increase the weaning weight and control the pre-weaning mortality, milk replacer is the only way out. Therefore, the present study was designed to assess the effect of feeding milk replacers on the growth performance and stress physiology in Ghoongroo piglets.

MATERIALS AND METHODS

Location of the study

The present study was conducted at the Piggery Unit under AICRP on Pig, Eastern Regional Station (ERS) of ICAR-Indian Veterinary Research Institute (IVRI), Kalyani, Nadia district, West Bengal, India, from March to November in the year 2022. The ERS of ICAR-IVRI, Kalyani is located in the lower Gangetic plain. The weather of Kalyani is warm and tropical; the extreme ambient temperature in summer rises to 39°C and the minimum temperature in winter goes down to about 8°C. The Laboratory works were carried out in the Department of Veterinary Biochemistry, West Bengal University of Animal and Fishery Sciences, Belgachia Campus, Kolkata.

Care and management of piglets during the experimental period

Piglets were selected from sows which were identical in parity. Piglets were weaned after 3 days after birth with almost similar body weight and reared on milk replacer till

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How to cite this article: Kumar, A., Ghosh, N. and Naskar, S. (2023). Effect of Feeding Milk Replacer on Growth Performance and Stress Physiology of Ghoongroo Piglets in Tropical Climate. Indian Journal of Animal Research. DOI: 10.18805/IJAR.B-5091.

Submitted: 25-01-2023 **Accepted:** 28-09-2023 **Online:** 14-10-2023

56 days of age. Fifteen-gram (15 g) milk replacer was reconstituted in 100 ml of lukewarm water and fed to the piglets using milk feeding bottle. All piglets under three (3) treatment groups were fed three (3) different types of milk replacers separately and individually to each piglet. Piglets were fed liquid milk replacer *ad-libitum* quantity in each feeding time. In first two weeks, feeding frequency was 2 hours interval *i.e*., 12 times in 24 hours. In third and fourth weeks of age, the feeding frequency was reduced to 10 times in 24 hours. Whereas, fifth and sixth week of age, the feeding frequency was 8 and 6 times, respectively in a day. Whereas, control group piglets were reared with their respective mothers. Their records of daily sow milk consumption were measured through indirect method and recorded till complete weaning. After 28 days of age, all the piglets in treatment as well as control group were gradually shifted to creep feeding along with milk replacers/sow milk.

Milk replacer composition

Milk replacers were formulated from incorporation locally available feed ingredients and also based *i.e*., Skim milk, maize flour/bajra flour/oats, whey protein, vegetable oil, antibiotics, vitamin and mineral mixture, *etc*. as per the standard limits based on the literature available. Milk replacers were consisting of a minimum: crude protein (CP): 25% (Min.) and crude fat (EE): 20% (Min.).

Recording of parameters

Body Weight and Stress physiology markers like sodium, potassium and cortisol in blood serum were analysed on the same day of collection during the experimental period.

Body weight

The body weight of animals (piglets) was measured with the help of digital spring balance and expressed in kilogram (kg). The animals were weighed just after farrowing (birth) and before separation from their dam *i.e*., on day 3 and thereafter on weekly basis *i.e*., from day 7 of age onwards up to 8 weeks (56 days) of age *i.e*., weaning age.

Calculation

Body weight gain (Kg.) = Body weight (N_a) - Body weight (N_b)
Where;
N_a- Body weight at 1st, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th week of age.
N_b- Body weight at 0th, 1st, 2nd, 3rd , 4th, 5th, 6th and 7th week of age.

Estimation of sodium and potassium in blood serum

Sodium and potassium concentrations in serum were analysed using a sodium colorimetric assay kit and a potassium turbidimetric assay kit (Elabscience, USA). The level was expressed as mEq/L.

Estimation of cortisol in blood serum

The Cortisol ELISA kit for serum estimation was supplied by Calbiotech, Inc. (CA, USA). The serum concentration of cortisol was measured using an ELISA reader. The serum cortisol level was expressed as µg/dL.

Statistical analysis

The data were analysed by using SPSS software (16.0 versions). The statistical method used to analyse the data were descriptive statistics, one-way ANOVA, two-way ANOVA, multivariate analysis using a general linear model and Duncan's multiple range test. The significant difference levels were set at 5% ($P<0.05$).

RESULTS AND DISCUSSION

Effect of milk replacer on growth performance

Growth performance of piglets was analyzed and presented in Table 1.

The Mean±SE of body weight of piglets showed significant ($P<0.05$) differences between treatments and control groups in various ages. The average body weight gain in treatment groups were much higher as compared to the control group.

Average daily gain (ADG) (g/day) presented in Table 2, revealed that there was a significant difference ($P<0.05$) between the control (T_0) and treatment groups (T_1, T_2 and T_3) of piglets. Overall body weight gain (g/day) of piglets was also varied significantly ($P<0.05$) between control (T_0) and treatment groups (T_1, T_2 and T_3).

This might be due to ad-libitum quantity of milk for the piglets in the T_1, T_2 and T_3 groups as compared to the T_0 group. Usually, availability of sow milk drastically declines after 21 days of lactation. That might be one the major reason of poor growth performance in control group piglets. Moreover, healthy and stronger piglets suckled more milk as compare to weaker ones. So, there was uneven growth of piglets at the time of weaning in control group. Whereas, there were no issues of milk availability in T_1, T_2, T_3 groups of piglets as they were fed individually *ad-libitum* quantity. Skorjanc *et al.* (2007) reported that sow milk and creep feed are not sufficient enough for the optimum growth of neonatal growing piglets especially heavier piglets with higher growth potential. So, if they were reared on a nutrient-dense milk replacer they showed their full growth potential and also recorded the highest litter weight at the end of weaning ($P<0.05$).

Wolter and Ellis (2001) reported that weaning weight and litter weight at weaning depends on the amount of milk consumed during lactation or the growing phase of life along with it also depends on the birth weight of piglets. Similar findings were reported by (Azain *et al*., 1996; King *et al*., 1998; Dunshea *et al*., 1999 and Wolter *et al*., 2002). They reported that weaning weight was increased by providing milk replacer in the neonatal phase and milk replacer also showed positive effects on the rate of growth and the weaning weight.

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Novotni-Danko *et al.* (2015) reported that piglets reared on sow milk weighed around 7-8 kg after the end of 4 weeks of age, indicating that there was a shortfall in milk supply to growing neonatal piglets, whereas he also found that if they n reared on milk replacer then the growth rate was significantly ($P<0.05$) much faster and up to the potential of the neonatal piglets that indicated that piglets showed their growth performance up to their full efficiency *i.e*., around 12-13 kg at the end of 4 weeks of age and that too without any deleterious effect on their health status. Therefore, providing piglets with supplemental liquid milk during lactation has a significant effect on growth performances, increased weaning weights, reduce pre-weaning mortality and showed a uniformity of a litter (Novotni-Dankó *et al*., 2015).

Azain *et al.* (1996) and Spencer *et al.* (2003) reported from their respective study that feeding milk replacers to neonatal piglets till weaning age significantly enhanced the weaning weight and total litter weight of piglets and also enhanced the performance efficiency during the post-weaning period. Supplementation of milk replacers resulted in a significant increase in weaning weight and total litter weight (Azain *et al*., 1996).

Nutrient intake of piglets was limited during the lactation period, which impacted the growth performance (Pluske *et al*., 2005). So, providing milk replacer during the neonatal phase improved body weight gain until weaning (Azain *et al*., 1996; Zijlstra *et al*., 1996; Dunshea *et al*., 1999; Wolter *et al*., 2002). Limited nutrient availability before weaning is a major determinant of average daily gain during this period (Klindt, 2003).

De-Greeff *et al.* (2016) reported that there was an increase in the growth of piglets after 3 weeks of NDM (nutrient-dense milk replacer) supplementation confirming previous findings describing beneficial effects on the growth performance of liquid milk replacer before weaning (Azain *et al*., 1996; Wolter *et al*., 2002; Park *et al*., 2014). This positive effect on weight is probably a consequence of the increased availability of nutrients due to the NDM. Nutrient-dense complex milk replacer (NDM) supplementation provides additional nutrients besides the sow's milk, especially later in lactation when sow milk production cannot adequately meet the needs of the litter to grow efficiently. Supplemental milk replacers provided during lactation can be used to increase weaning weights. This is particularly useful under conditions such as heat stress when milk

Table 1: Least squares mean±SE of body weight growth rate of Ghoongroo piglets till weaning (8 weeks of age).

Parameter	Day (Age)	T_0		T_1		T_2		T_3	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Body weight (Kg)	0th Day (Birth weight)	1.06	0.02	1.06	0.05	1.06	0.05	1.06	0.04
	7th	2.02^{c}	0.06	2.16^{bc}	0.15	2.58^{a}	0.07	2.46^{ab}	0.12
	14th	2.98^{c}	0.13	4.17^{b}	0.30	5.70^{a}	0.14	4.65^{b}	0.20
	21st	3.97^{d}	0.14	7.18^{b}	0.70	8.57^{a}	0.26	5.92^{c}	0.08
	28th	5.37^{c}	0.14	9.04^{ab}	1.05	10.44^{a}	0.29	8.06^{b}	0.25
	35th	6.61^{b}	0.18	11.13^{a}	1.40	12.08^{a}	0.27	10.44^{a}	0.29
	42nd	7.74^{b}	0.14	13.11^{a}	1.96	14.30^{a}	0.25	12.08^{a}	0.27
	49th	9.11^{b}	0.27	15.24^{a}	2.39	16.75^{a}	0.40	14.30^{a}	0.25
	56th	10.17^{b}	0.31	18.02^{a}	2.66	19.52^{a}	0.44	16.75^{a}	0.40

Row-wise means with different superscripts differ significantly (Significant $P<0.05$).

Table 2: Least squares mean (±SE) of average body weight gain during respective weeks and overall body weight gain till weaning (8 weeks of age) of Ghoongroo purebred piglets.

Weekly average weight gain (g)	T_0		T_1		T_2		T_3	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
1st Week	137.14^{c}	10.15	157.14^{bc}	27.39	216.57^{a}	10.35	199.72^{ab}	19.94
2nd Week	137.14^{c}	14.00	287.14^{b}	23.52	445.71^{a}	20.28	312.86^{b}	28.57
3rd Week	141.71^{b}	3.60	429.43^{a}	69.85	409.71^{a}	27.57	182^{b}	20.26
4th Week	199.71	30.75	266.57	64.15	267.43	11.70	305.57	32.14
5th Week	177.14^{b}	17.41	297.71^{a}	68.20	234.29^{ab}	8.57	339.57^{a}	20.59
6th Week	161.43^{b}	13.29	283.43^{ab}	80.75	317.14^{a}	24.08	234.29^{ab}	8.57
7th Week	195.71^{b}	29.07	304.29^{ab}	64.51	350.00^{a}	31.14	317.14^{ab}	24.08
8th Week	151.43^{b} ±	7.28	396.86^{a}	44.95	395.72^{a}	24.29	350.00^{a}	31.14
Overall	162.68^{b}	5.55	302.82^{a}	47.76	329.57^{a}	7.67	280.14^{a}	6.99
Overall body weight gain (Kg.)	9.11^{b}	0.31	16.96^{a}	2.67	18.46^{a}	0.43	15.69^{a}	0.39

Row-wise means with different superscripts differ significantly (Significant $P<0.05$).

Table 3: Least squares mean (±SE) of biological stress marker (Cortisol, Sodium, Potassium) in blood (Serum) of Ghoongroo purebred piglets till weaning.

Parameter	Day (Age)	T_0		T_1		T_2		T_3	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Cortisol (µg/dl)	3rd	5.88	0.07	5.88	0.07	6.13	0.06	5.34	0.05
	14th	6.12	0.07	6.12	0.07	6.31	0.04	5.76	0.05
	28th	5.92	0.07	5.78	0.06	5.44	0.07	5.92	0.07
	42nd	5.40	0.07	5.40	0.07	5.40	0.07	5.66	0.05
	56th	5.04	0.05	5.65	0.07	5.36	0.07	5.04	0.05
Serum sodium (mEq/L)	3rd	138.00	1.87	136.20	1.30	138.00	1.87	136.60	1.82
	14th	140.80	1.30	138.40	1.67	140.80	1.30	141.00	2.00
	28th	142.60	1.14	141.00	1.00	140.40	2.41	142.60	1.14
	42nd	141.40	1.82	141.60	1.67	141.40	1.82	142.40	0.89
	56th	143.60	1.14	144.80	1.10	143.20	1.92	143.60	1.14
Serum potassium (mEq/L)	3rd	4.06	0.11	4.20	0.08	4.06	0.11	4.00	0.16
	14th	4.26	0.11	4.41	0.07	4.26	0.11	4.34	0.11
	28th	4.30	0.16	4.30	0.12	4.26	0.11	4.30	0.16
	42nd	4.36	0.11	4.26	0.11	4.36	0.11	4.22	0.08
	56th	4.50	0.16	4.45	0.11	4.52	0.08	4.50	0.16

production in the sow is lower and weaning weights are decreased (Azain *et al*., 1996).

The study reported by Spencer *et al.* (2003) showed the benefit of decreasing sow lactation length and supplying milk replacer to piglets during periods of heat stress to conserve sow tissue loss, improve subsequent reproductive efficiency and regain piglet growth lost due to decreased sow milk yield. By reducing sow tissue loss, producers can improve reproductive efficiency lost to high environmental temperatures, especially in herds containing a high percentage of first-litter females.

Zijlstra *et al.* (1996) reported that artificially reared pigs showed similar or superior weight gains compared with sow-reared pigs. Feeding a milk replacer increased weight per unit of length compared with suckled pigs, which coincides with the increase in the rate of body weight gain. Feeding milk replacers in the early post-weaning period may help the pig to overcome the post-weaning growth lag. Enhanced weight gain in pigs fed milk replacers during this period was due to increased intake and consisted of a concerted increase in both protein and fat accretion. Some experiments have shown that increased weight gain in the early post-weaning period resulted in reduced time to reach market weight; however, verification that feeding milk replacer in the early post-weaning period will reduce time to market is needed.

Litters fed supplemental milk replacers during lactation grew faster ($P<0.001$) and were heavier ($P<0.001$) at weaning than un-supplemented litters (Azain *et al*., 1996; King *et al*., 1998; Dunshea *et al*., 1999; Wolter and Ellis, 2001). The intake of milk replacers had no significant effect on mortality up to 8 weeks post-weaning: 91% of the piglets raised without milk replacer and 90% of the piglets raised with milk replacer, survived (Royeaerd *et al*., 1989).

Dunshea *et al.* (1999) reported that piglets reared on milk replacer showed ADG of 310 g/day till weaning compared to the normal piglets reared on sow milk and differed significantly. These findings from Dunshea *et al.* (1999) were corroborated by our findings from the present study of Ghoongroo purebred piglets.

Effect of milk replacer on stress physiology markers

Values of stress physiology markers in the blood (serum) play an important role in assessing animals' health status and productivity potentiality. Statistically analysed data (Table 3) revealed that piglets were not underwent any stress by changing the feed for neonatal piglets from sow milk to milk replacer. The stress markers in the blood (serum) of the control group and treatment groups indicated no significant difference. The findings from the present study showed that cortisol, sodium and potassium values in serum (blood) were nearly at par with the normal reference values of piglets as cited in the literature (Friendship *et al*., 1984; Klem *et al*., 2010; Harvey, 2012; Buzzard *et al*., 2013; Perri *et al*., 2017). The present findings were in accordance with (Podder *et al*., 2022; Stevačević *et al*., 2019; Abeni *et al*., 2018; Al-Mashhadi *et al*., 2018; Kabalin *et al*., 2017; Newell Fugate *et al*., 2014).

CONCLUSION

This investigation revealed that feeding a suitable milk replacer significantly influences growth performance and did not reflect any adverse effect on the health status and productivity of piglets by providing a suitable milk replacer in the neonatal stage of life which is manifested in the stress physiological markers of the blood serum.

ACKNOWLEDGEMENT

Authors have sincere gratitude toward the Dean, F/O VAS, WBUAFS, Kolkata and Head, ICAR-Indian Veterinary Research Institute (ERS), Kolkata for providing all facilities

for this study and all who assisted in direct/indirect ways towards completion of this study work.

Conflict of interest: None.

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