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## Effects of $\alpha$ -Tocopherol on chilled quality parameters of Tharparkar bull semen extended in Lecithin and Tris based egg yolk extender

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**ABSTRACT:** This study was conducted to evaluate the effect of  $\alpha$ -Tocopherol (Vit E) on chilled semen quality parameters of Tharparkar bull. For the purpose of the present study, 52 ejaculates were collected from four bulls initially semen samples were evaluated for progressive motility, morphology and viability (Eosin-Nigrosin staining technique) and membrane integrity (Hypo-osmotic Swelling test). Samples having  $\geq 70\%$  of all above mentioned parameters were pooled and extended into a Lecithin based extender and Tris based egg yolk extender supplemented with  $\alpha$ -tocopherol (Vit E) 0.02 mM and cooled at 4°C for 2 hours. The semen samples were subsequently assessed for progressive motility, morphology, viability and membrane integrity. Spermatozoa supplemented with  $\alpha$ -tocopherol in Lecithin based extender showed improved parameters, compared to spermatozoa supplemented with  $\alpha$ -tocopherol in Tris-based extender in terms of progressive motility (79.09 $\pm$ 0.87 vs 74.69 $\pm$ 0.94%), morphology (86.13 $\pm$ 0.79 vs 82.81 $\pm$ 1.00%), viability (82.13 $\pm$ 1.20 vs 77.63 $\pm$ 1.26%) and membrane integrity (81.40 $\pm$ 0.77 vs 77.31 $\pm$ 1.01%). In conclusion the addition of  $\alpha$ -tocopherol improved the chilled quality parameters of Tharparkar bull semen extended in a Lecithin based extender as compared to Tris based egg yolk extender.

**Keywords:** Cryopreservation, Tharparkar Bull Semen, Chilled Semen,  $\alpha$ -tocopherol, Lecithin based extender.

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## INTRODUCTION

Tharparkar cattle was derived from Thar Desert (Chand, 2011) in Sindh, Pakistan. It is a *Bosindicus*, lyre-horned breed found in India-Pakistan border area of Thar Desert and considered a dual-purpose breed valued for its milk as well as draught utility (Godara *et al.*, 2015). It is considered highly resistant to tick-borne disease with good heat tolerance capacity, Tharparkar cattle breed is deep, alert and powerfully built & medium-sized with limbs straight & good feet (Sanjay *et al.*, 2018).

Cryopreservation is one of the techniques of assisted reproductive technologies in which semen is preserved for future use (Olaciregui *et al.*, 2014). This technique is widely used for domestic animals and humans (MotaFilho *et al.*, 2014). Cryopreservation accelerates genetic improvement, enhances animal production and contributes to eliminate contagious diseases (e.g. Brucellosis) and preserve endangered species (Bucak *et al.*, 2009). During cryopreservation the quality of semen is deteriorated, which leads to low fertilization rates (Ardon and Saurez, 2013). Cryopreservation induces thermal shock, toxic stress, osmotic disturbance, and ice crystals formation (Watson, 2000). During freeze-thawing Reactive Oxygen Species (ROS) are produced, while the accumulation of ROS and the lack of antioxidants result in DNA fragmentation, lipid peroxidation and premature capacitation (Miguel-Jimenez *et al.*, 2020; Upadhyay *et al.*, 2021). Thus, the supplementation of semen extender with additives, such as antioxidants seems very promising to ensure the quality of semen.

An extensive effort has been made towards the improvement of media and preservation protocols during cryopreservation. Lecithin based extender (BIOXcell™: IMV Technologies, L'Agile, France) is a mixture of several fatty acids i.e. Palmitic, Oleic and Stearic acids which maintains stability of cell membrane and results in higher progressive motility compared to lab-based extenders. Moreover, the improved progressive motility parameters of spermatozoa extended in Lecithin based extender could be due to increased amount of glutathione (Stradaioli *et al.*, 2007). The composition of Tris extenders is highly variable, while the microbial load and the presence of endotoxins involve the risk of negative impact on sperm progressive motility and viability (Apu *et al.*, 2012). In comparison to Lecithin based extender, studies suggest that egg yolk based extender is more effective for bull sperm viability and fertilizability (Crespilho *et al.*, 2014; Kaka *et al.*, 2015).

Various antioxidants have been employed, such as  $\alpha$ -Tocopherol (Vit E), Vit C and Co-enzyme Q<sub>10</sub>, which act as scavengers and prevent cellular damage.  $\alpha$ -Tocopherol is a lipid soluble antioxidant that helps to control lipid peroxidation, Adding of antioxidant vit E ( $\alpha$ -Tocopherol) in the extender will inhibit the process of lipid peroxidation reaction that helps to manage the oxidation process of phosphorylation, which is responsible for the elevating level of ROS in the sperm.

Many studies have been addressed in exotic cattle breeds, but few of them refer to indigenous Tharparkar cattle bull. Therefore, this study was designed with a hypothesis that supplementation of  $\alpha$ -Tocopherol into a Lecithin based extender and Tris-based egg yolk extender would improve chilled quality parameters of Tharparkar cattle bull semen.

## MATERIALS AND METHODS

### Bulls preparation & Collection of Semen

For the purpose of this study four Tharparkar bulls, 4-5 years old were housed under semi-intensive farming system at Department of Animal Reproduction, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Sindh, Pakistan. Routine vaccination and drenching were followed according to farm schedules. Total 52 ejaculates (n=13) were collected with the help of Artificial Vagina (Internal Temperature 45-48 °C and air pressure of 35-44 mmHg) from September to early December 2021. After semen collection, samples were shifted to SPU (Semen Production Unit) for macroscopic and microscopic semen analysis. Moreover, samples with progressive motility, morphology and viability  $\geq 70\%$  were pooled and extended and further assessed.

### Semen evaluation

#### Macroscopic Semen evaluation

##### Volume

The volume of semen was observed through visual examination with the help of graduated tube.

##### Colour

Visual examination was done for judgment of colour however semen was categorized as Milky, Creamy white and Translucent.

##### pH

pH was determined by a digital pH meter.

## Microscopic Semen evaluation

### Wave motion

The wave motion was assessed on a clean warm dry slide by putting a drop of undiluted semen under low power of magnification (10X) with phase contrast microscope (Nikon, Germany). Wave sample was recorded and classified as described by Rehman et al., (2012).

**Table 2.1:** Wave Motion Assessment Scale Mass Progressive Motility

Scale	Assessment
0	Nil mass activity
+	<20% of sperm motion
++	40-60% showing movement with the slow wave
+++	Wave showing more intense and movement 60-80%
++++	Wave making eddies describing movement 80-100%

### Progressive Motility

For the assessment of percentage of progressive motility, semen diluted with normal saline (1:100). One drop of diluted semen was taken and putted on pre-warmed slide by applying a cover slip on it. One hundred spermatozoa were randomly selected spermatozoa moving backward or in circle were not counted. The results were expressed as %, samples with  $\geq 70\%$  progressive motility was treated for further evaluation.

### Concentration of sperm

Concentration of sperm was determined with a haemocytometer.

### Sperm morphology and Viability

As per standard staining procedure of sperm, morphology was determined as described by (Björndahl et al., 2003). From each sample four smears were prepared and 100 spermatozoa were evaluated in terms of morphology and viability. Viability and abnormalities were assessed in 100X magnification.

### Membrane integrity

Hypo Osmotic Swelling (HOST) test was used to determine membrane integrity of fresh samples, according to Revell and Mrode, (1994).

### Experimental design of semen extension

Ejaculates qualifying the standard criteria of Macroscopic parameters: volume (3-6ml), colour (V/E), pH (6-7) and Microscopic parameters (concentration

( $1 \times 10^9$ /ml), progressive motility ( $\geq 70\%$ ), morphology and viability ( $\geq 70\%$ ) and membrane integrity ( $\geq 70\%$ ) were pooled and diluted in the Tris based egg yolk and Lecithin based extender then divided into four groups consisting of Tris control, Tris+ 0.2mM  $\alpha$ -tocopherol (Vit E), Lecithin based extender control and Lecithin based extender +0.2mM  $\alpha$ -tocopherol (Vit E). Rate of dilution was based on initial sperm concentration and it was adjusted to have 20 million spermatozoa in 0.25 ml straw.  $\alpha$ -tocopherol (Vit E) 0.2mM concentration was selected from the study conducted by (Kaka, 2015b). Diluted semen samples were cooled at 4°C for 02 hours.

### Extension of semen

Each semen sample was diluted with Tris based egg yolk extender and Lecithin based extender as described by Kaka, 2015a.

### Equilibration

The equilibration was completed within 2 hours at 4°C.

### Chilled semen evaluation

Chilled semen evaluation were followed after thawing at 37°C for 30 seconds in which progressive motility, morphology, membrane integrity and viability of the spermatozoa were evaluated.

### Statistical analysis

Collected data were subsequently subjected to one-way analysis of variance (ANOVA) using Statistics (2006) and LSD was used to determine difference among means of different groups.

## RESULTS

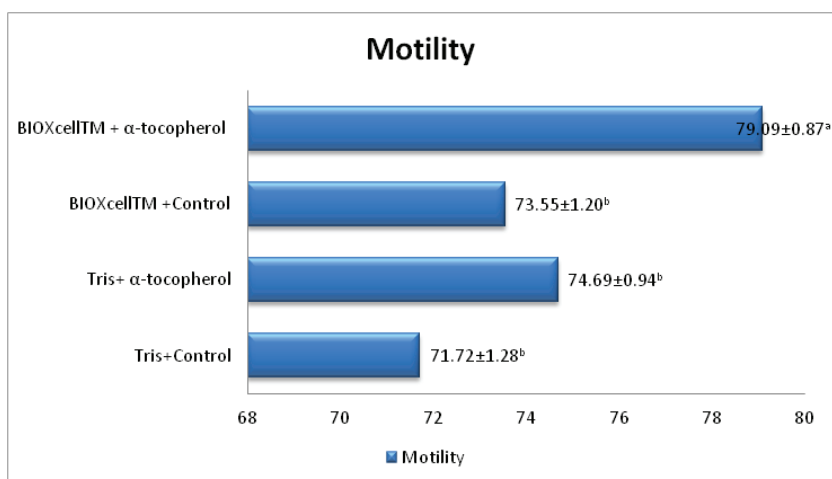
Chilled semen assessment of Tharparkar bull semen (Mean %  $\pm$  SEM) in Lecithin based extender and Tris based egg yolk extender supplemented with and without vit E ( $\alpha$ -Tocopherol) 0.02 mM.

The Mean ( $\pm$ SE) progressive motility were significant among all groups ( $P < 0.05$ ). However addition of  $\alpha$ -Tocopherol showed improved progressive motility of spermatozoa in Lecithin based extender (79.09 $\pm$ 0.87) followed by Tris based egg yolk extender (74.69 $\pm$ 0.94), compared to Lecithin based extender (73.55 $\pm$ 1.20) and Tris control (71.72 $\pm$ 1.28) as are depicted in Figure 3.1. The Mean ( $\pm$ SE) Morphology was also significantly different in all groups ( $P < 0.05$ ), Tris-Control, Tris +  $\alpha$ -Tocopherol, Lecithin

based extender + Control and Lecithin based extender +  $\alpha$ -Tocopherol, However, numerically highest and improved values were observed in Lecithin based extender +  $\alpha$ -Tocopherol ( $86.13 \pm 0.79$ ) as compared to Tris-Control ( $78.90 \pm 1.01$ ), Tris supplemented with  $\alpha$ -Tocopherol ( $82.81 \pm 1.00$ ) and Lecithin based extender Control ( $80.81 \pm 0.96$ ) as shown in Figure 3.2.

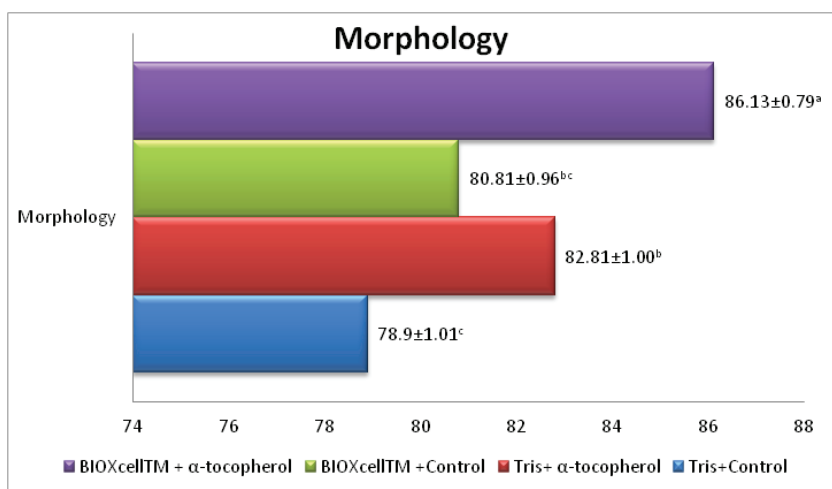
Furthermore, Improved viability was also noted in Lecithin based extender ( $82.13 \pm 1.20$ ) supplemented with  $\alpha$ -Tocopherol as compared to Tris-Control ( $74.04 \pm 1.31$ ), Tris supplemented with  $\alpha$ -Tocopherol ( $77.63 \pm 1.26$ ) and Lecithin based extender Control ( $76.02 \pm 1.28$ ) and there were no significant difference among groups ( $P < 0.05$ ) Figure 3.3. The Mean ( $\pm$ SE)

Membrane Integrity of each group is detailed Figure 3.4, The significant difference was observed among all groups ( $P < 0.05$ ), Tris-Control, Tris +  $\alpha$ -Tocopherol, Lecithin based extender + Control and Lecithin based extender +  $\alpha$ -Tocopherol, among the all groups numerically highest improved membrane integrity value were observed in Lecithin based extender +  $\alpha$ -Tocopherol ( $81.40 \pm 0.77$ ) as compared to Tris-Control ( $73.18 \pm 1.29$ ), Tris supplemented with  $\alpha$ -Tocopherol ( $77.31 \pm 1.01$ ) and Lecithin based extender Control ( $75.31 \pm 1.20$ ). The fluctuation in results might be due to variance in the techniques of preservation, dilution, temperature, intrinsic and extrinsic factors such as breed, age, climate, environment, management and so on so forth (Sansone et al., 2000).



**Figure 3.1** Progressive motility of Tharparkar bull chilled semen (Mean %  $\pm$  SEM) extended in Lecithin based extender and Tris based egg yolk extender supplemented with or without 0.02mM  $\alpha$ -tocopherol (Vit E)

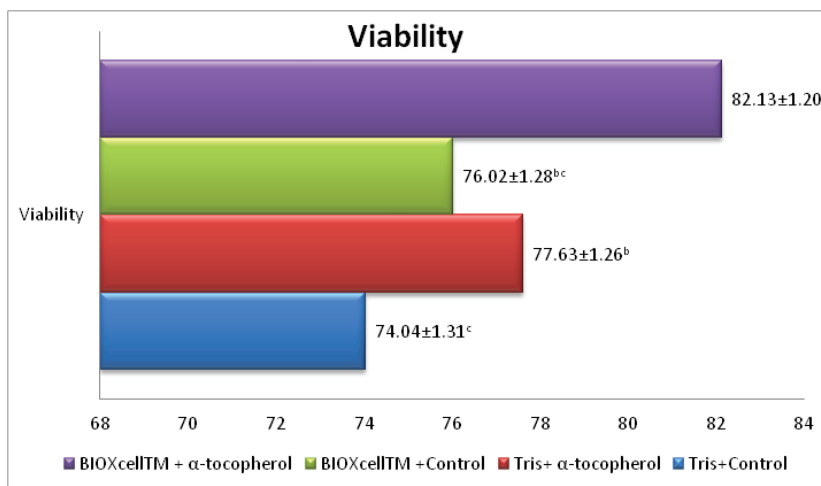
ab: values with different superscripts shows significant difference ( $P < 0.05$ ).



**Figure 3.2** Chilled semen Morphology of Tharparkar bull semen (Mean %  $\pm$  SEM) in Lecithin based extender and Tris based egg yolk extender supplemented with and without  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml.

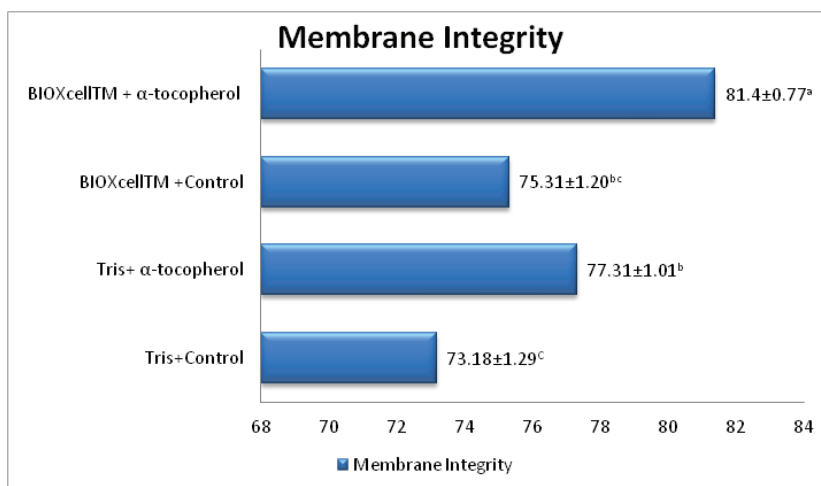
abc: values with different superscripts shows significant difference ( $P < 0.05$ ).





**Figure 3.3** Chilled semen Viability of Tharparkar bull semen (Mean %  $\pm$  SEM) in Lecithin based extender and Tris based egg yolk extender supplemented with and without  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml.

abc: values with different superscripts shows significant difference ( $P < 0.05$ ).



**Figure 3.4** Chilled semen Membrane Integrity of Tharparkar bull semen (Mean %  $\pm$  SEM) in Lecithin based extender and Tris based egg yolk extender supplemented with and without  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml.

abc: values with different superscripts shows significant difference ( $P < 0.05$ ).

## DISCUSSION

### Chilled Semen Assessment

Generally it is considered that the cryopreservation process itself reduces more than 50 percent of the Progressive Motility and viability of spermatozoa. During the different stages of cryopreservation spermatozoa face chemical osmotic and thermal stress (Leboeuf et al., 2000). Addition of  $\alpha$ -tocopherol into semen resulted improvement in quality parameters of frozen-thawed bull spermatozoa i.e. Progressive motility, morphology, viability and membrane integrity in both Lecithin based extender and Tris based egg yolk extender. Sperm parameters were improved in all groups supplemented with  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml. The spermatozoa showed improved

progressive motility parameter in Lecithin based extender supplemented with  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml, The obtained results agreed with previous studies observed by Ansari et al., (2012), However, the value were higher than Kaka et al., (2015a) Thari Semen and Yadav et al., (2019) Hariana Bull.

Morphological study of spermatozoa showed improved quality parameters Lecithin based extender supplemented with  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml. The obtained results agreed with the findings of Kaka et al., (2015) and Yadav et al., (2019). However, results of current obtained morphology were higher than Ansari et al., (2012). The viability of spermatozoa is one of the fundamental characteristic which is linked with maturation of spermatozoa (Kathiravan et

al., 2011). The greater viability of spermatozoa were seen in Lecithin based extender supplemented with  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml which agreed with results carried out by Yadav et al., (2019) and current findings were lower than the values obtained by Ansari et al., (2012) and Kaka et al., (2015).

Membrane Integrity of spermatozoa were also assessed and it was highest in Lecithin based extender supplemented with  $\alpha$ -tocopherol (Vit E) 0.02 Mm/ml. The obtained value of spermatozoa membrane integrity is in agreement with results observed by Yadav et al., (2019) and the present value of current study is lower than the results observed by Ansari et al., (2012) and Kaka et al., (2015).

Addition of  $\alpha$ -tocopherol (Vit E) at concentration of 0.02 Mm/ml improves chilled semen quality parameters of Tharparkar bull semen in both extenders, Meanwhile most of findings suggests that egg yolk extender are more effective over Lecithin based extender based extenders (Crespilho et al., 2014), These variations in results might be due to variance in the techniques of

preservation, dilution, temperature, intrinsic and extrinsic factors such as climate, environment, management and use of extenders with different compositions or it depends on the use of antioxidants. Meanwhile use of various concentrations of antioxidants presents variations in results (Sansone et al., 2000).

## CONCLUSION

Supplementations of  $\alpha$ -Tocopherol (Vit E) within Lecithin based extender and Tris-based egg yolk extender resulted improved Chilled quality parameters of Tharparkar Bull Semen.

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## CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

## REFERENCES

- Ansari M, Towhidi A, Shahrbabak MM, Bahreini M, 2012. Docosahexaenoic acid and alpha-tocopherol improve sperm cryosurvival in goat. *Slovak J Anim Sci*, 45 (1):7-13.
- Apu AS, Yahia KM, Hussain SS, Fakruzzaman M, Notter DR, 2012. A comparative study of fresh and frozen-thawed semen quality in relation to fertility of black bengal goats semen from six adult male black bengal goats. *Iran J Appl Anim Sci*, 2:157-161.
- Ardon F, Suarez SS, 2013. Cryopreservation increases coating of bull sperm by seminal plasma binder of sperm proteins BSP1, BSP3, and BSP5. *Reprod*, 146 (2):111-117.
- Björndahl L, Söderlund I, Kvist U, 2003. Evaluation of the one-step eosin-nigrosin staining technique for human sperm vitality assessment. *Hum Reprod*, 18 (4):813-6.
- Bucak MN, Tuncer PB, Sariözkan S, Ulutaş PA, 2009. Comparison of the effects of glutamine and an amino acid solution on post-thawed ram sperm parameters, lipid peroxidation and anti-oxidant activities. *Small Rumin Res*, 81 (1): 13-17.
- Chand T, 2011. *Genetic Evaluation of Lifetime Productivity in Tharparkar Cattle* (Doctoral dissertation, Rajasthan University of Veterinary and Animal Sciences, Bikaner-334001).
- Crespilho AM, Nichi M, Guasti PN, Freitas-Dell'Aqua CP, Sa Filho MF, Maziero RR, Dell'aqua JA, Jr, Papa FO, 2014. Sperm fertility and viability following 48h of refrigeration: evaluation of different extenders for the preservation of bull semen in liquid state. *Anim Reprod Sci*, 146:126-133.
- Godara AS, Tomar AKS, Patel M, Godara RS, Bhat SA, Bharati P, 2015. Body Conformation in Tharparkar Cattle as a Tool of Selection. *J Appl Anim Res*, 5 (3):423-430.
- Kaka A, 2015b. <http://psasir.upm.edu.my/id/eprint/56730/1/FPV%2012RRR>, pp. 88-118.
- Kaka A, Samo MU, RahooTH, Rehman ZU, Shah Z, Mushtaq M, Kaka U, Behan AA, 2015a. Study on post-thawing quality of Thari semen. *JAPS*, 22 (2):59-62.
- Kaka A, Wahid H, Rosnina Y, Yimer N, Khumran AM, Sarsaifi K, Behan AA, Kaka U, Ebrahimi M, 2015.  $\alpha$ -Linolenic acid supplementation in Lecithin based extender® extender can improve the quality of post-cooling and frozen-thawed bovine sperm. *Anim Reprod Sci*, 153:1-7.
- Kathiravan P, Kalatharan J, Karthikeya G, Rengarajan K, Kadirvel G, 2011. Objective sperm motion analysis to assess dairy bull fertility using computer-aided system-a review. *Reprod Domest Anim*, 46 (1):165-172.
- Leboeuf B, Restall B, Salamon S, 2000. Production and storage of goat semen for artificial insemination. *Anim Reprod Sci*, 62 (1-3):113-141.
- Miguel-Jimenez S, del Alamo MMR, Alvarez-Rodríguez M, Olegario Hidalgo C, Peñá AI, Muñero R, Rodríguez-Gil JE, Mogas T, 2020. In vitro assessment of egg yolk-, soya bean Lecithin based extender- and liposome-based extenders for cryopreservation of dairy bull semen. *Anim Reprod Sci*, 1-37. doi:<https://doi.org/10.1016/j.anireprosci.2020.106315>.
- Mota Filho AC, Silva HVR, Nunes TGP, de Souza MB, de Freitas LA, de Araújo AA, da Silva LDM, 2014. Cryopreservation of canine epididymal sperm using ACP-106c and TRIS. *Cryobiology*, 69 (1):17-21.
- Olaciregui M, Gil L, Monton A, Luno V, Jerez RA, Marti JI, 2014. Cryopreservation of epididymal stallion sperm. *Cryobiology*, 68 (1):91-95.
- Rehman FU, 2012. *Substitution of animal protein source with plant protein in semen extenders of various cattle breeds* (Doctoral dissertation, M.Phil. Tesis, Faculty of Animal Husbandry and Veterinary Sciences Khyber Phaktunkhwa Agricultural University Peshawar Pakistan. Pakistan). 9-20.
- Revell SG, Mrode RA, 1994. An osmotic resistance test for bovine semen. *Anim Reprod Sci* 36 (1-2):77-86.
- Sanjay C, Yamini, Deepandita B, Kotresh PC, Girish P, Rohit K, Ajit K, 2018. Tharparkar : the pride of desert. *J Entomozool Stud*, 6 (2):1915-1919.
- Sansone GMJF, Nastri MJF, Fabbrocini A, 2000. Storage of buffalo (Bubalus bubalis) semen. *Anim Reprod Sci*, 62 (1-3):55-76.
- Stradiaili G, Noro T, Sylla L, Monaci M, 2007. Decrease in glutathione (GSH) content in bovine sperm after cryopreservation: comparison between two extenders. *Theriogenology*, 67 (7):1249-1255.
- Upadhyay VR, Ramesh V, Dewry RK, Kumar G, Raval K, Patoliya P, 2021. Implications of cryopreservation on structural and functional attributes of bovine spermatozoa: An overview. *Andrologia*, 53 (8):e14154.
- Watson PF, 2000. The causes of reduced fertility with cryopreserved semen. *Anim Reprod Sci*, 60:481-492.
- Yadav D, Singh V, Yadav SS, Patel A, Kumar A, Sonkar V, Kumar A, Yadav S, Kumar B, Yadav B, Saxena A, 2019. Effect of glutathione on viability and progressive Progressive Motility of Haryana bull spermatozoa during cryopreservation in semi-arid region. *J Pharm Innov* 8 (6):871-876.