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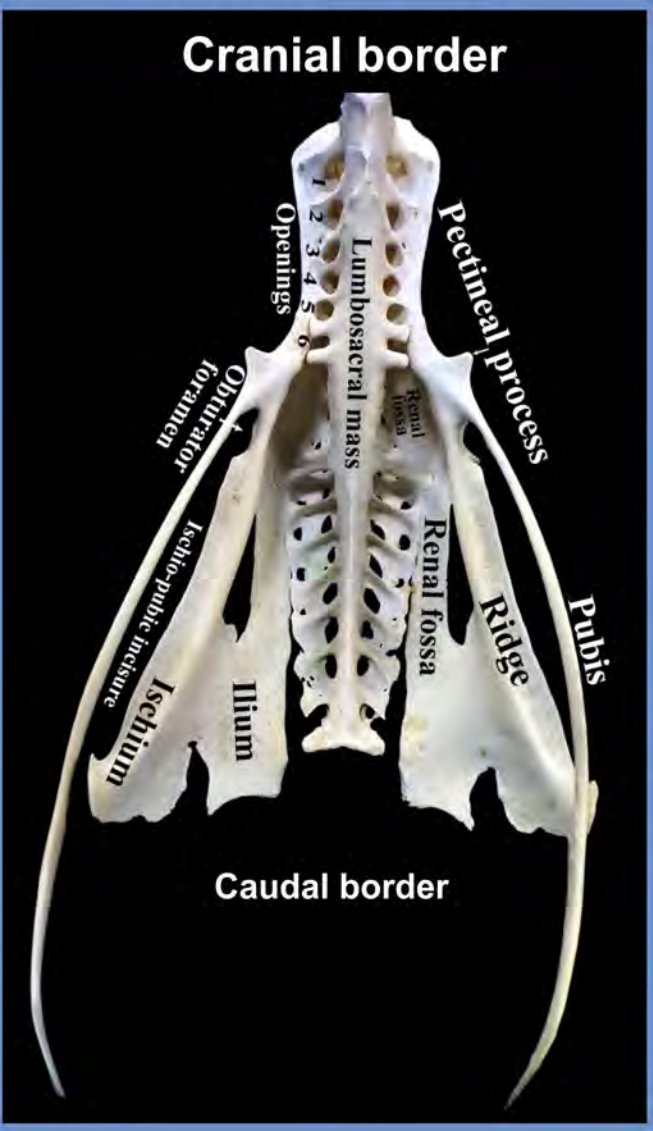

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Full length articles

Short Communications

Full Length Articles

MORPHOLOGICAL AND MORPHOMETRIC STUDIES ON THE PELVIC GIRDLE OF CHINESE GOOSE (*ANSER CYGNOIDES*)

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ABSTRACT

The pelvic girdle of Chinese goose was a large, elongated bone, narrow cranially (3.0 cm) and wide (8.0 cm) caudally. It consisted of two os coxae, each of which was made up of an ilium, an ischium and a pubis. The ilium of the Chinese goose was the largest and longest (14 cm) bone of the os coxae. The pre-acetabular part of the ilium was 6.80 cm long and 2.0 cm wide. The post-acetabular part of ilium was 7.2 cm long. The ilioneural canal was slightly broad in front and narrow caudally.The pelvic surface of ilium showed six openings on either side of the bodies of the lumbosacral mass. The ischiatic foramen was 3.60 cm long and 1.20 cm wide. The ischium was triangular in shape and 7.50 cm long. The caudal border of the pelvis was wide (7.50 cm) and showed a deep notch. The pubis was long (12.0cm), thin, bent rod-like bone, projected well beyond the caudal border of the os coxae and bent medially. The pectineal process was short and rounded. Pneumatic foramina were absent in the os coxae of the Chinese goose. The acetabulum was large and formed by all the three bones. The anti-trochanter was quadrilateral in shape and prominent.

Key words: os coxae, pelvic girdle, ilium, ischium, pubis

INTRODUCTION

The Chinese geese are the most graceful and beautiful member of the goose family and referred to as 'swan geese' or 'weeder geese'. They are identified by the knob at the base of its beak. There are two varieties of Chinese geese, brown and white. The white variety has blue eyes, pure white plumage, and bright orange feet, knobs and bills. Sexes are similar but the males have larger knob at base of bill (Holderread, 1981). The pelvic girdle of the birds is related to their bipedal standing posture because their hind limbs are only structure for support and walking. Hence, they require a solid connection between the pelvis and the vertebral column but also maximum area for the insertion of the muscles which bear the bulk of the body weight. At the same time the ventrally open pelvis forms a dorsal, roof-like covering for

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a large part of the body cavity and the organs contained in them (Nickel *et al*., 1977).

The present study was undertaken because the anatomical information available on this bird was scanty.

MATERIALS AND METHODS

The carcasses of three Chinese geese were utilised for the present study. After the post-mortem examination the carcasses were allowed for biological maceration. The disintegrated skeleton was cleaned with fresh water and soaked in 10-15% NaHCO3 solution for whitening. Then the skeleton was dried and morphological and morphometric studies were performed by using vernier caliper and ruler.

RESULTS AND DISCUSSION

The pelvic girdle of Chinese goose was a large, elongated bone, narrow cranially (3.0 cm) and wide (8.0cm) caudally. It consisted of two equal bones, and was made up of an ilium, an ischium and a pubis (Fig.1), as reported by Nickel *et al.* (1977) in birds.

The ilium was a thin, long plate of bone, the ischium was comparatively thick plate and the pubis was a slender rod–like bone. The space between the pelvic bones was occupied by lumbosacral mass (Fig.1) as reported by McLelland (1990) in fowl.

The ilium of the Chinese goose was the largest and longest (14 cm) bone of the os coxae. It had a pre-acetabular and a post-acetabular part. The pre-acetabular part was 6.80 cm long, 2.0 cm wide and concave in its length. The post-acetabular part was 7.2 cm long and 1.0 cm wide in the cranial half and 1.50 cm wide in the caudal half (Fig.3). It is in agreement with the observations of Barvalia and Panchal (2019) in emu. In contrary, in cattle egret the pre-acetabular part was longer and post-acetabular part was short and broad (Rezk, 2015), and in crested serpent eagle and brown wood owl the pre-acetabular part was much longer than the post-acetabular part (Keneisenuo *et al.,* 2019).

In the present study, the pre-acetabular part was quadrilateral in shape, its gluteal surface was concave, vertical in the dorsal two-thirds and dorsally facing in the ventral one-third (Fig.3). In emu, the ilium was lying vertical to the long axis of the body (Santhilakshmi *et al.,* 2007).

The cranial border of the ilium was narrow, slightly convex, and triangular in shape and projected cranially.It formed the cranial iliac crest (Fig.3). In emu the cranial border of the ilium was notched at the middle and projected laterally (Barvalia and Panchal, 2019).

The dorsal border was convex and fused with the dorsal ends of the lumbosacral mass completely and formed a bony bridge.The dorsal borders formed the dorsal iliac crests. The dorsal iliac crest was less prominent and present on either side of the dorsal median ridge and extended from the cranial border up to the caudal border of the acetabulum. Caudally above the level of acetabulum it was thick (Fig.3) as observed by Mehta *et al.* (2013) in coturnix quail. Sreeranjini *et al*. (2011) noticed that in peahen, this ridge extended up to its posterior extremity. But in emu,

there was no line of demarcation between the pre and post-acetabular parts (Barvalia and Panchal, 2019).

The lateral borders were thin and slightly convex cranially but became thick and rounded and concave near the acetabulum and formed the cranial acetabular rim and also joined with the cranial border of the pectineal process (Fig.3). In peahen the lateral border of the pre-acetabular part of ilium was highly concave and thin (Sreeranjini *et al*., 2011).

The pelvic surface of the pre-acetabular part of the ilium was fused with the spines and transverse processes of the lumbosacral mass, enclosing a space in between, the ilioneural canal (Fig.2). The ilioneural canal was slightly broad in front and became narrow caudally. It is in agreement with the findings of Fitzgerald (1969) in couturnix quail, Nickel *et al*. (1977) in chicken and Lavanya *et al.* (2017) in guinea fowl. In contrary in pigeon (Lavanya *et al*., 2017) and in peahen (Sreeranjini *et al*., 2011) the cranial one third of the dorsal border of the ilium did not fuse with the lumbosacral spines and hence the ilioneural canal was not formed.

The pelvic surface showed six openings on either side of the bodies of the lumbosacral mass for the exit of the spinal nerves (Fig.2). Four large foramina were noticed in Indian eagle owl (Sarma *et al*., 2018) and in brown wood owl (Keneisenuo *et al*., 2019) and five foramina were noticed in crested serpent eagle (Keneisenuo *et al*., 2019).

Caudally about the level of acetabulum the pelvic surface showed a deep depression, the renal fossa, which was oval in shape (Fig.2). It is in accordance with the observations of Rezk (2015) in cattle egret and Sarma *et al*. (2018) in Indian eagle owl. In contrary, in emu (Mehta *et al.,* 2013) and in bar-headed goose (Sasan *et al.,* 2017), no renal fossa was present.

In Chinese goose, the post-acetabular part of the ilium was quadrilateral in shape, long (7.2 cm), narrow (1.0 cm) cranially up to the level of the caudal end of the ischiatic foramen and wide caudally (1.5cm) and sloping downwards and placed more or less vertically (Fig.3). It is in agreement with the observations of Nickel *et al*. (1977) in duck and goose. Barvalia and Panchal (2019) reported that in emu the post-acetabular part was prismatic, narrower but longer than the pre-acetabular part. In coturnix quail (Fitzgerald, 1969) and in Indian eagle owl (Sarma *et al.,* 2018) the post-acetabular part was narrow and faced dorsally. Whereas in peahen, the pre-acetabular part was longer and wider than the post-acetabular part (Sreeranjini *et al.,* 2011).

The dorsal border of the post-acetabular part of the ilium was thick and fused with the lateral edges of the transverse processes of the lumbosacral mass in the cranial one third but thereafter a gap was present between the two which widened gradually towards the caudal end (Fig.1). In contrary, in peahen, only the caudal two-thirds of medial border united with the transverse process of synsacrum (Sreeranjini *et al*., 2011). Nickel *et al.* (1977) observed that, in fowl and pigeon they joined syndesmotically.

The post-acetabular parts of the ilium were separated by the transverse processes of the lumbosacral vertebra. They were widely separated about the level of the acetabulum, thereafter the width of the transverse processes gradually reduced so the gap between the dorsal borders of the ilia reduced gradually up to the level of the caudal end of the ischiatic foramen, thereafter they were placed more or less parallelly (Fig.1).

The ventral free border of the post-acetabular part of the ilium from behind the anti-trochanter was thin and enclosed along with the dorsal border of the ischium a large, elongated, oval opening, the ischiatic foramen (Fig.3), as reported by Nickel *et al*. (1977) in fowl. The ischiatic foramen was 3.60 cm long and 1.20 cm wide in Chinese goose. In peahen the ischiatic foramen was oval in shape and was 2.30cm long and 1.30 cm wide (Sreeranjini *et al*., 2011). McLelland (1990) reported that this foramen transmits the ischiatic nerves in birds. In emu, the ischium and ilium were separated and had the ilio-ischiatic incisure, rather than a foramen (Kumar and Singh, 2014).

Behind the ischiatic foramen the ilium and ischium were fused (Fig.3). The pelvic surface of the post-acetabular part of the ilium showed a long, narrow, shallow depression extended up to the level of the caudal border of the ischiatic foramen, the renal fossa (Fig.2). It is in accordance with the observations of Rezk (2015) in cattle egret, Sarma *et al*. (2018) in Indian eagle owl and Keneisenuo *et al*. (2019) in crested serpent eagle and brown wood owl. In contrary, in emu (Mehta *et al.,* 2013) and in bar-headed goose (Sasan *et al.,* 2017), no renal fossa was present.

The lateral surface of the post-acetabular part of the ilium was smooth, slightly convex in the cranial free part but concave in the caudal broad part. The caudal border of the ilium was concave and broad, its caudodorsal end was blunt and rounded and the caudoventral end showed a pointed projection extending downwards and backwards. This pointed projection looked similar to the caudal process of other birds (Fig.1).The caudal end of the ilium in fowl and pigeon (Nickel *et al.*, 1977), spot - billed pelicans (Sathyamoorthy *et al.*, 2012) and in guinea fowl (Lavanya *et al.,* 2017) showed a distinct and dorsally projected caudal process. But the caudal process was not very distinct in peahen (Sreeranjini *et al*., 2011).

In the Chinese goose, the median crest formed by the fused spinous process of the synsacrum and it was present cranially, but absent at the level of acetabulum and in the caudal one third it was present (Fig.1). Lavanya *et al*. (2017) observed that, in pigeon, the bony ridge was present throughout the length of the lumbosacral mass whereas in guinea fowl, the bony ridge formed by the spines of synsacrum was noticed only in the anterior part and caudally it was seen as a narrow groove.

The os coxae of the Chinese goose did not show pneumatic foramina. It is in agreement with the findings of Hogg (1984), who found that there was a very low incidence of pneumatisation in the os coxae of domestic fowl. In contrary, Sreeranjini *et*

al. (2011) informed that the pelvic girdle of peahen present large number of air cavities.

The ischium of the Chinese goose was triangular, elongated plate of bone, narrow cranially and broad caudally. It was 7.50 cm long, 0.70 cm wide behind the acetabulum and 2.20cm wide at the caudal end. It extended from the acetabulum to the caudal border of the os coxae. Its cranial part involved in the formation of caudal rim of acetabulum (Fig.3), as observed by Nickel *et al*. (1977) in birds. It was placed in a slanting position and extended laterally. The caudoventral angle of the ischium presented a broad plate like projection, the angulus ischiadicus which joined syndesmotically with the dorsal border of the pubis (Fig.3). It is in accordance with the observations of Nickel *et al*. (1977) in duck and goose. But in peahen the angulus ischiadicus was blunt and did not fuse with the pubis (Sreeranjini *et al.,* 2011).

The lateral surface of the ischium was slightly concave in the cranial half and slightly convex in the caudal half. Its medial surface showed a thick, rounded ridge throughout the length (Fig.2). The dorsal free border in the cranial half formed the ventral boundary of the ischiatic foramen. The ventral border of the ischium was thin and sharp. It showed a small, smooth area immediately behind the acetabulum, behind this it showed a small bony ridge and later it was continued by the long thin slightly concave ventral border of the ischium. Between it and the dorsal border of the pubis it enclosed a large ischio-pubic incisure and posteriorly closed by the junction between the angulus ischiadicus and the pubis. The ischio-pubic incisures was 7.0 cm long and 1.0 cm wide at the centre (Fig.3). It is in accordance with the observations of Nickel *et al*. (1977) in duck and goose, the pubo-ischiatic incisure was not divided but remained as a narrow elongated oval incision. In contrary in fowl (Nickel *et al*., 1977), guinea fowl and pigeon (Lavanya *et al*., 2017) and Indian eagle owl (Sarma *et al*., 2018) the ischio-pubic incisure was divided into an obturator foramen in front and an incisure behind. Deshmukh *et al*., (2016) reported that in pea fowl, the angulus ischiadicus, the ventral end of the caudal border of the ischium was blunt and did not fuse with the pubis. McLelland (1990) reported that the ischiatic foramen transmitted the ischiatic nerves in birds. In emu, the ischium and ilium were separated and had the ilio-ischiatic incisure, rather than a foramen (Kumar and Singh, 2014).

The caudal border of the pelvis was formed by the caudal borders of ilium and the ischium. The caudal border was very wide (7.50cm) and shallow (3.0cm height) because of the deviation of the caudal part of the ilium and ischium laterally. The caudal border presented a deep notch between the ilium and ischium (Fig.1), as reported by Nickel *et al*. (1977) in goose. In duck only a small notch was present (Nickel *et al*., 1977). Kumar and Singh (2014) reported that in emu, the posterior extremity of the os coxae was interrupted due to non-continuation of all the three bones.

In the present study, the pubis was long (12.0cm), thin, bent rod-like bone which followed the ventral border of the ischium and projected well beyond the caudal border of the os coxae and bent medially. It was thin cranially in the cranial one third, slightly

thicker in the middle one third and formed a syndesmotic junction with the plate- like angulus ischiadicus and in the caudal one third free part its width increased and at the caudal end it ended in a shovel-like process which curved medially (Fig.3). It is in total agreement with the observations of Nickel *et al*. (1977) in duck and goose. Mehta *et al.* (2014) reported that, in Japanese quail the pubis did not project beyond the ilium and ischium. In Indian eagle owl the caudal end of the pubis was bent medially to meet with its fellow of opposite side (Sarma *et al*., 2018).

In Chinese goose the dorsal border of the pubis was concave cranially and convex caudally from the junction with the angulusischiadicus (Fig.3). Accordingly in ostrich (Tamilselvan *et al*., 2015) the pubis was a long slender bone, dorsally concave in front and convex behind. Its caudal extremity extended beyond the ilium and ischium and bent medially and formed pubic symphysis. The pubic symphysis supported the weight of the abdomen. The caudal one third of pubis also fused dorsally with the ischium.

The cranial end of pubis participated in the formation of acetabulum (Fig.3) as reported by Nickel *et al.*(1977) in pigeon and goose, but in fowl and duck it was fused with the ischium below the acetabulum.

In Chinese goose, the pectineal process was short and rounded in the Chinese goose (Fig.3). Nickel *et al.* (1977) reported that the pectineal process was long thorn-like in the fowl, absent in pigeon, and rudimentary in duck and goose. The pectineal process was rudimentary in peahen (Sreeranjini *et al.*, 2011), absent in Japanese quail (Mehta *et al.*, 2014), Indian eagle owl (Sarma *et al.*, 2018), and spot-billed pelicans (Sathyamoorthy *et al.*, 2012). Kumar and Singh (2014) reported that, in emu the pectineal process was slightly broader towards the cranial extremity of pubis to participate in the formation of acetabulum. He also informed that, under development of this process might lead to paralysis of hind limb.

In the present study, the acetabulum was formed by ilium, ischium and pubis as observed by Sathyamoorthy *et al.* (2019) in blue and yellow macaw. It was circular, large (1.0cm diameter) and perforated (Fig.3) Nickel *et al.* (1977) reported that, in fowl and duck, the pubis was not involved in the formation of acetabulum.

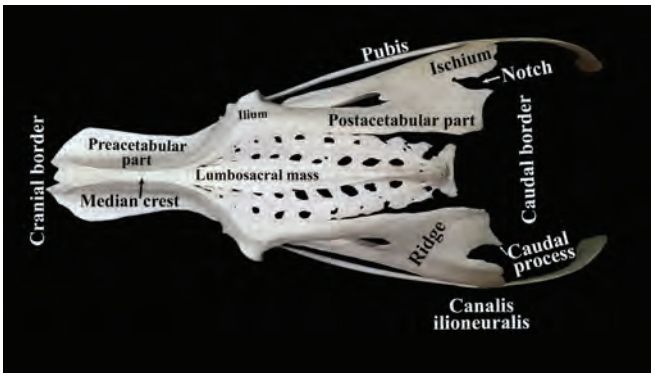

Fig. 1 Pelvic girdle of Chinese goose – dorsal view

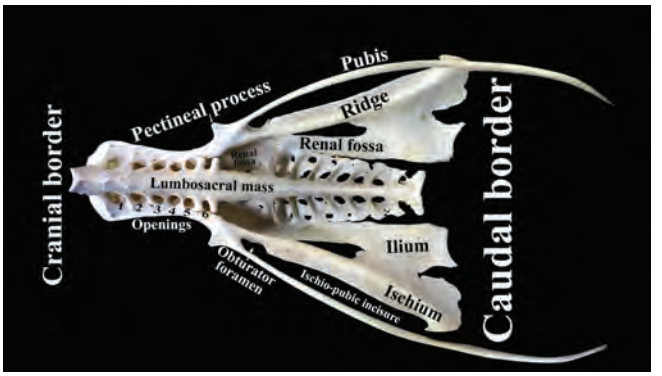

Fig. 2 Pelvic girdle of Chinese goose – ventral view

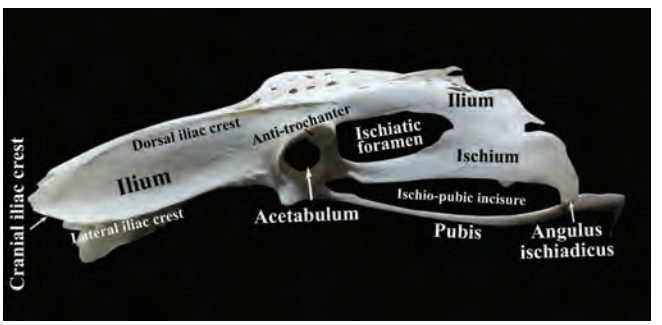

Fig. 3 Pelvic girdle of Chinese goose – Lateral view

The floor of the acetabular rim was broad, but the cranial and caudal parts of the rim were narrow. Caudodorsal rim of the acetabulum showed a bony prominence measured 0.9 cm long, with thick edges and carried a concave, elongated, quadrilateral shaped facet with rounded dorsal border and a straight ventral border, projecting dorsolaterally, the anti-trochanter (Fig.3) as observed by Rezk (2015) in cattle egret and Sarma *et al*. (2018) in Indian eagle owl. McLelland (1990) reported that, the anti-trochanter femur articulation reinforces weak adductor muscles and limits abduction of the limb. Hertel and Campbell (2007) found that, in birds, the anti-trochanter serves as a brace to prevent abduction of the hind limb and to absorb stress that would otherwise be placed on the head of the femur during bipedal locomotion.

REFERENCES

Barvalia, I. and Panchal, K.M. (2019). Gross and biometric studies on pelvic bone of the emu (*Dromaius novaehollandiae*). *The Indian Journal of Veterinary Sciences and Biotechnology,* **14**(4)**:** 21-24.

Deshmukh, S.K., Karmore, S.K., Gupta, S.K., Kodape,S. and Prakash,R. (2016). Comparative biometrical studies on the os coxae and synsacrum of peacock and peahen.*Veterinary Practitioner,*17 (1):41-42.

Fitzgerald, T.C. (1969). The Coturnix Quail, Anatomy and Physiology. The Iowa State University Press, Ames, Iowa, pp. 26-27.

Hertel, F. and Campbell Jr., K.E. (2007). The anti-trochanter of birds: Form and function in balance. *The Auk*, **124**(3):789-805.

Hogg, D.A. (1984). The distribution of pneumatisation in the skeleton of the adult domestic fowl. *Journal of Anatomy*, **138**: 617-629.

Holderread, D. (1981). The Book of Geese-A complete guide to raising the home flock. 1st ed.The hen house, Corvallis, Oregon, USA.

Keneisenuo, Choudhary, O.P., Arya, R.S., Kalita, P.C., Doley, P.J., Rajkhowa, T.K. and Kalita, A. (2019). Comparative gross morphological studies on the os coxae of crested serpent eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*).*Journal of Animal Research*, **9** (3):439-442.

Kumar, P. and Singh, G. (2014). Gross anatomy of wing and pelvic limb bones in emu (*Dromaius novaehollandiae)*. *Indian Journal of Veterinary Anatomy*, **26**(2):82-86.

Lavanya, C., Jayachitra, C., Iniyah, K. and Balasundaram, K. (2017).Comparative anatomy of os coxae in guinea fowl and pigeon. *International Journal of Current Microbiology and Applied Science*s, **6**(9):3655-3659.

McLelland, J .A. (1990).Colour Atlas of Avian Anatomy, Wolf Publishing Ltd., England.pp.42-43.

Mehta, S., Guha, K. and Singh, K.K. (2013). Gross anatomical studies on the os coxae and synsacrum of emu (*Dromaius novaehollandiae*). *Indian Veterinary Journal*, **90** (9): 79-81.

Mehta, S., Guha, K., Shalini, S. and Kumar, C. (2014).Gross anatomical studies on the os coxae and synsacrum of Japanese quail. *Indian Journal of Veterinary* Anatomy, **26**(2):126-127.

Nickel, R., Schummer, A. and Seiferle, E. (1977). Anatomy of the Domestic Birds, 1st ed.Verlag Paul Parey, Berlin, Hamburg, pp.13-19.

Rezk, H.M. (2015). Anatomical investigation on the appendicular skeleton of the cattle egret *(Bubulcus ibis). Journal of Experimental and Clinical Anatomy,* **14**(1): 5-12.

Santhilakshmi, M., Chandra Sekhara Rao, T.S., Jagapathi Ramayya, P. and Ravindra Reddy, Y. (2007). Gross anatomical studies on the os coxae and femur of Emu (*Dromaius novaehollandiae*). *Indian Journal of Poultry Science*, **42**(1): 61-63.

Sarma, K., Suri, S. and Sasan, J.S. (2018). Gross anatomical studies on os coxae of Indian eagle owl (*Bubo bengalensis*). *Exploratory Animal and Medical Research*, **8**(2): 208-210.

Sasan, J.S., Suri, S. and Sarma, K. (2017). Gross anatomical studies on the os coxae of bar-headed goose (*Anser indicus*).*The Indian Veterinary Journal*, **94**(5): 09-10.

Sathyamoorthy, O.R., Richard Churchil, R. and Karunakaran, N. (2019).Gross anatomical studies on the pelvic

girdle of blue and yellow macaw (*Ara ararauna*). Journal of Entomology and Zoology Studies, **7**(6): 694-698.

Sathyamoorthy, O.R., Thirumurugan, R., SenthilKumar, K. and Jayathangaraj, M.J. (2012).Gross morphological studies on the pelvic girdle of spot-billed Pelicans (*Pelicanus philippensis*). *Indian Journal of Veterinary Anatomy,* **24**(2):109-110.

Sreeranjini, A.R., Ashok, N., Indu, V.R., Lucy, K.M., Syam, K.V., Chungath, J.J. and Harshan, K.R. (2011). Morphological studies on the pelvic girdle of a peahen (*Pavo cristatus*). *Journal of Indian Veterinary Association,* **9**(3):46-48.

Tamilselvan, S., Iniyah, K., Jayachitra, S., Sivagnanam, S., Balasundaram, S. and Lavanya, C. (2015). Gross anatomy of Os coxae of Ostrich (*Struthio camellus*). *International Journal of Current Microbiology and Applied Sciences*, **4**(4): 201-205.

UTILISATION PATTERN OF ICT (INFORMATION COMMUNICATION TECHNOLOGY) AMONG UNDERGRADUATE VETERINARY STUDENTS IN SOUTHERN STATES OF INDIA

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ABSTRACT

A study was undertaken with the objective of assessing the utilisation pattern of ICT (Information Communication Technology) among undergraduate veterinary students in southern states of India. Data were collected from 248 final year undergraduate students of 12 veterinary colleges in five southern states of India viz. Tamil Nadu, Kerala, Karnataka Andhra Pradesh and Telangana through pretested questionnaire. The findings of the study revealed that majority of the students studied had 3-4 years of experience in using internet and accessed internet through mobile phone (61.29%). One-third (33.06%) of the students used internet 2-3 days in a week for academic activity while, 30.65% used internet every day for personal activity. The study revealed that students used internet mainly for the preparation of assignments (97.58%). The major problems faced by the students in using ICT tools were slow speed of internet (77.82%) and inadequate number of computers (75.81%) in the institutions. It could be concluded that veterinary students had accessed substantial information technology resources and had knowledge towards computer and internet. Provision of structured information technology training for veterinary students would help them to acquire necessary skills to maximise the utilisation of online veterinary resources.

Key Words*:* ICT, veterinary, students, utilisation, internet, e-learning.

INTRODUCTION

The use of ICT in all spheres of human endeavour has become increasingly evident over the past decade, with people of all ages making use of computers and internet to interact, communicate and do business on a daily basis (Louw and Hanmer, 2002). ICT can create new opportunities to bridge the gap between information have and have not's in the developing countries. Globalisation and technological change process have accelerated in tandem over the past fifteen years and it created a new global economy powered by technology, fuelled by information and driven by knowledge. The emergence of the knowledge driven economy has tremendous influence over

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the educational institutions which has the responsibility to develop human resources for ever increasing demand of the society, country and the world.

All over the world, the higher education institutes are continually undergoing significant changes, mostly in response to the emerging development brought about by the impact of ICT. They have begun to realise how to strategically position the ICT to ensure greatest positive effect on university success (Romaniello *et al*., 2010). Many of the educational institutions have adopted the components of ICT to facilitate the students with access to the maximum resources for curriculum. Veterinary science is not an exception to the above trend. In academic activities, problem and case based learning by using ICTs to aid students in accumulating knowledge and to help them how to think and solve problems. Further, strategies to integrate ICT into veterinary education system must consider their specific utilisation of ICT tools. Against this backdrop, the present study was undertaken to assess the utilisation pattern of ICT among undergraduate veterinary students.

MATERIALS AND METHODS

Exploratory research design was followed in this study. The study was carried out among final year undergraduate students of 12 veterinary colleges in five southern states of India viz. Tamil Nadu, Kerala, Karnataka, Andhra Pradesh and Telangana. A sampling frame was constructed from the students registered for final year from all the selected colleges and the total strength of final year students of all the twelve colleges were 694. From this sampling frame, 248 students were selected using proportionate random sampling method. A well structured and pretested questionnaire was used to elicit the data from the respondents. Data were collected personally from the respondents from January 2014 to April 2014. Appropriate statistical tools were employed to analyse the data and interpretation were made out based on the results of the analysis.

RESULTS AND DISCUSSION

Utilisation pattern of internet

More than two-fifth of the students (43.15%) opined that their knowledge level in internet usage is good followed by very good (21.37%), excellent (13.71%), satisfactory (10.89%), fair (9.27%) and poor (1.61%) (Table 1). This finding contradicts with the finding of Ravi and Isthari (2011) they observed that about half of the research students of Hyderabad University had average knowledge. More than three-fifth (61.29%) of the students acquired internet skills through self learning followed by guidance from friends (53.63%). This finding gains support from the finding of Loan (2011) who reported that the students learned internet by self instruction through trial and error and differs with the finding of Thanuskodi (2013) who observed that more than half of the rural students in India acquired internet skill through training from college.

Table 1. Utilisation pattern of internet (n=248)

S. No	Category	Frequency	Percentage
1	**Knowledge in internet**		
	Excellent	34	13.71
	Very good	53	21.37
	Good	107	43.15
	Fair	23	9.27
	Satisfactory	27	10.89
	Poor	4	1.61
2	**Mode of acquiring internet skills***		
	Self learning	152	61.29
	Training courses	17	6.86
	Guidance from friends	133	53.63
	Guidance from relatives	18	7.26
	Guidance from college staff	13	5.24
	School education	7	2.82
3	**Experience in using internet**		
	Less than one year	11	4.43
	1-2 years	42	16.94
	3-4 years	86	34.68
	5-6 years	53	21.37
	Above 6 years	56	22.58
4	**Source of Internet access***		
	Through mobile phone	152	61.29
	Through personal computer	57	22.98
	Computer centre in the institute	112	45.16
	Through private cyber cafe	41	16.53
	Institution library	90	36.29
	In hostel	17	6.86
5	**Frequency of use for academic activity**		
	Every day	45	18.15
	2-3 days in a week	82	33.06
	Once in a week	52	20.97
	Once in a month	17	6.85
	Occasionally	52	20.97

6	**Frequency of use for personal activity**		
	Every day	76	30.65
	2-3 days in a week	64	25.81
	Once in a week	34	13.71
	Once in a month	17	6.85
	Occasionally	57	22.98
7	**Purpose of using internet***		
	Preparing assignment	242	97.58
	Downloading course materials	219	88.31
	Research project	75	30.24
	For getting information regarding treatment	183	73.79
	Job search	87	35.08
	Mere browsing	87	35.08
	Sending and receiving mails	189	76.21
	Online shopping	121	48.79
	Downloading softwares	139	56.05
	News and sports update	153	61.69
	Playing games	123	49.60
	For watching movies and video songs	164	66.13
	Uploading	111	44.76
	Chatting	160	64.52
	Pornography	69	27.82
8	**Benefit of using internet over conventional learning materials***		
	Time saving	197	79.44
	Time consuming	45	18.15
	Easy to use	204	82.26
	Difficult in use	23	9.27
	More informative	200	80.65
	Less informative	30	12.10
	More expensive	107	43.15
	Less expensive	89	35.89
	More useful	185	74.60
	Less useful	28	11.29
	More preferred	156	62.90
	Less preferred	59	23.79
9	**Usage of computer and internet in veterinary education**		
	Needed	240	96.77
	Not needed	8	3.23

*Multiple response

Just above one-third (34.68%) of the students had experience of 3-4 years in using internet, followed by above 6 years (22.58%), 5-6 years (21.37%), 1-2 years (16.94%) and less than one year (4.43%). This finding contradicts with the finding of Thanuskodi (2013). Most of the students (61.29%) accessed internet through mobile phones followed by institution's computer centre (45.16%), institution library (36.29%), personal computer (22.98%), private cyber cafe (16.53%) and hostel (6.86%). The students informed that mostly they are using mobile phone for accessing social network sites and this might be the reason for using mobile phone as a source of internet access. This finding is in accordance with the finding of Jato and Oresiri (2013) who noticed that 63.12% of Nigerian students accessed internet through mobile phone.

One-third of the students (33.06%) used internet 2-3 days in a week for academic activity but 30.65% used internet every day for personal activity. The main purpose of using internet among students was preparing assignments (97.58%) followed by downloading course materials (88.31%), sending and receiving mails (76.21%), getting information regarding treatment (73.79 %), watching movies and video songs (66.13%), chatting (64.52 %), news and sports update (61.69%) and downloading software's (56.05%).

More than three-fourth of the students opined that internet was easy to use (82.26 %), more informative (80.65%) time saving (79.44%) and more useful (74.60%) than conventional learning materials. Further, overwhelming majority of the students (96.77%) felt that the computer and internet was needed in veterinary education.

The students had good knowledge and experience in using internet and it helps to keep oneself abreast of the latest developments in veterinary education. Hence, introduction of online modules in veterinary education pave the way for excellence in learning among students.

Utilisation pattern of e-books

Friends were the major source of awareness for half of the students (49.60%) in utilisation of e-books. Three-fourth (74.20%) of the respondents were not regularly using e-books. Among the regular users, 46.88% used monthly and occasionally, 34.37% and 18.75% of the students used e-books weekly and daily respectively (Table 2). The major reasons cited by the students for not using e-books were preference for paper books(55.98%), no interest (30.98%) and little knowledge on how to use (29.35%). Ismail and Zainab (2005) also reported that preference for paper books was the major reason for not using e-books.

Table 2. Utilisation pattern of e-books (n = 248)

S. No	Category	Frequency	Percentage
1	**Source of awareness of e-books***		
	Friends	123	49.60
	College staff	71	28.63
	Web sites	61	24.60
	Librarians	50	20.16
	Others	16	6.45
2	**Regularity in use of e-books**		
	Regular	64	25.80
	Not regular	184	74.20
a	**If regularly used, frequency of use**		
	Daily	12	18.75
	Weekly	22	34.37
	Monthly	15	23.44
	Occasionally	15	23.44
b	**If not regular, reasons for not using e-books***		
	Prefer paper books	103	55.98
	No internet connection	38	20.65
	No interest	57	30.98
	Little knowledge on how to use	54	29.35
	Inconvenient	43	23.37
	Difficult to browse and read	49	26.63
	Need special software	43	23.37
	Physical problems	12	6.52

*Multiple response

E-books are the recent addition to paper books and there is an increasing awareness among students on e-books. The less frequent usage of e-books indicates that it has not been fully explored as potential learning tool. The learning materials of veterinary education should be available in the form of e-books and it would encourage the use of e-books among students.

Usage of e-learning vet website

The e-learning vet website was developed by Tami Nadu Veterinary and Animal Sciences University and launched in the year 2009 - 10 to cater the needs of undergraduate veterinary students. The semester wise course contents for all the courses in B.V.Sc & A.H degree is available in text, power point and voice over format. The e-learning vet website was known to 91.53% of the students and the source of awareness was mainly teachers (51.54%) and friends (42.73%). This was rarely used by more than two-fifth of the students (42.73%). Nevertheless, more than one-fourth (28.64%) used it weekly while 18.50 and 9.25% used monthly and daily respectively (Table 3).

Table 3. Usage of e-learningvet website (n= 248)

S. No	Category	Frequency	Percentage
1	**Awareness regarding e-learning vet website**		
	Aware	227	91.53
	Not aware	21	8.47
2	**Source of awareness***		
	Library sources	80	35.24
	Teachers	117	51.54
	Friends / other students	97	42.73
	Accidental browsing in the net	15	6.61
	Any other	3	1.32
3	**Frequency of use**		
	Daily	21	9.25
	Weekly	65	28.64
	Monthly	42	18.50
	Rarely	97	42.73
	Never	2	0.88
4	**Usefulness of material**		
	Greater extent	144	63.44
	Smaller extent	81	35.68
	Not at all useful	2	0.88
5	**Satisfaction**		
	Highly satisfied	29	12.78
	Satisfied	175	77.09
	Less satisfied	22	9.69
	Not satisfied	1	0.44

*Multiple response

Nearly two-third (63.44%) of the students felt that the e-learning materials were useful to a greater extent and 77.09% were satisfied in using e-learning materials. The results indicate that the students' in veterinary education is being benefitted to a greater extent by the e-learning vet materials.

Problems faced by the students in using ICT tools

The problems faced by the students in using ICT tools were analysed and presented in Table 4. The first and foremost problem experienced by the students was very slow internet speed (77.82%). The other important problems faced by the students were inadequate number of PC in lab (75.81%), slow speed of PC (75.00%), unfamiliarity with search strategies (66.13%) and retrieval of specific information difficult (62.10%). Upgrading the processor speed, increasing the bandwidth for internet connection and increasing the numbers of PC would solve the problems of students in using ICT tools. Formal training to students in search strategies and retrieval of specific information would improve the utilisation of ICT and also enhances the students' performance.

Table 4. Problems faced by the students in using ICT tools (n=248)

S. No	Problems	Total		Rank
		Frequency*	Percentage	
1	Slow speed of PC	186	75.00	III
2	Inadequate number of PC in lab	188	75.81	II
3	Lack of time to use e-resources	142	57.26	VII
4	Frequent electricity failure	104	41.94	X
5	No computer lab	20	8.06	XIII
6	No internet connectivity	51	20.56	XII
7	No campus computer network	82	33.06	XI
8	Very slow internet speed	193	77.82	I
9	Restricted hours of usage	139	56.05	VIII
10	Lack of operational skills	117	47.18	IX
11	Limited accessibility to database through use of passwords	146	58.87	VI
12	Unfamiliarity with search strategies	164	66.13	IV
13	Retrieval of specific information difficult	154	62.10	V

*Multiple response

CONCLUSION

Veterinary students had access to substantial information technology resources and had knowledge towards computer and internet. Provision of structured information technology training for veterinary students would help them to acquire necessary skills to maximise the utilisation of online veterinary resources.

REFERENCES

Ismail, R. and Zainab, A.N. (2005). The pattern of e-book use amongst undergraduates in Malaysia: A case of to know is to use. *Malaysian Journal of Library and Information Service*,**10**(2): 1-23.

Jato, M. and Oresiri, J. (2013). Students use of search engines for information retrieval on the web: A case study of Adeyemi College of education, Ondo. *Greener Journal of Internet, Information and Communication Systems*, **1**(2): 55-60.

Loan, F.A. (2011). Internet use by the college students across discipline: A study. *Annals of Library and Information Studies*, **58**: 118-127.

Louw, J.A. and Hanmer, L. (2002). Implications of the information revolution for economic development in South Africa. Department of Trade and Industry Policy Support Programme Management Unit. Fehrsen and Bronkhorst Street, New Mucleneuck, Pretoria, South Africa.

Ravi, B. and Isthari, B. (2011). Use of internet services at IGM library, University of Hyderabad: A study. *SRELS Journal of Information Management*, **48** (2): 181-188

Romaniello, A., Rey, U., Carlos, J. and Medlin, D. (2010). Higher education success and ICT. *Bulletin of Applied Computing and Information Technology*, **7**(1): 109.

Thanuskodi, S. (2013). Awareness and use of ICT among undergraduate degree students of rural areas in Tuticorin district, India: A study. *International Journal of Information Science*, **3**(1): 1-6.

DOSAGE MINIMIZATION OF CHLORINE TO IMPROVE WATER QUALITY AND ITS APPLICABILITY FOR SHRIMP LARVAL REARING OPERATIONS IN HATCHERY

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ABSTRACT

Administration of higher dosage of chlorine leads to a concern about proper dosage determination for shrimp hatchery operations. Hence, the dosage application needs to be reworked at the present context. Accordingly a Completely randomized design experiment with 6 treatments (control, 10 ppm, 20 ppm, 30 ppm, 40 ppm, 50 ppm of active chlorine content) with 3 replications was conducted. The water quality and the bacterial load were monitored once in 3 hours continuously. The salient observations of the study was that the exposure time for residual chlorine to be nil for the tank with chlorination of 10 ppm concentration was 6 hours, for 20 ppm and 30 ppm it was 18 hours and for 40 ppm and 50 ppm it was 21 hours. Also the results shows that bacterial load was nil in all the treatments viz. 10 to 50 ppm. The pH of the water gets increased and then stabilized. It could be concluded from the study that the chlorination is required in shrimp hatcheries. But the optimum dosage is 10 ppm for ensuring better water quality in shrimp hatchery which is very much less when compared to the general dose of upto 30 ppm for other purposes. Another experimental trial with three replications was conducted to ascertain the survival of post larvae of P. monodon from PL5 to PL 20 with the 10 ppm active chlorine. The study showed that survival was high in 10 ppm..

Key Words: Chlorine, Hatchery, Shrimp larvae, Water quality

INTRODUCTION

Incoming water used in shrimp hatcheries should be disinfected prior to use to minimize the chance of viral, bacterial, fungal and protozoan diseases entering and causing disease problems in the hatchery. Current methods for the disinfection of seawater, which reduce bacterial loading in water supplies and/or avoid blooms of potentially pathogenic microorganisms, include treatments with antibiotics, ozone, filtration, heat, and UV irradiation (Whipple and Rohovec, 1994; Pascho *et al.,* 1995; Chang *et al.,* 1998; Liltved and Cripps, 1999; Munro *et al.,* 1999; Frerichs *et al.*, 2000). However, each of these treatments has specific disadvantages such as high cost, need for sophisticated equipment, production of toxic residues for the cultured

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organisms, or the appearance of resistant microorganism strains (Liltved *et al.,* 1995; Bullock *et al.,* 1997; Reilly and Kaferstein, 1997).

The commonest and best chemical treatment for such disinfection is the use of chlorine in the hatchery. Chlorine has a high efficiency as a disinfectant, and is readily available at low cost and in its various forms has been widely used for microbiological control in seawater and for surface sanitation in some intensive aquaculture facilities (White, 1992; Pascho *et al.,* 1995). Laboratory and field studies have demonstrated the high biocidal efficiency of chlorine against viruses and bacterial pathogens (Sako *et al.,* 1988; Inouye *et al.,* 1990; Frerichs, 1990; Pascho *et al.,* 1995; Arimoto *et al.,* 1996; Chang *et al.,* 1998). At allowable levels, chlorine does not affect flora or fauna. If an excess amount of chlorine is released by accident into aquatic environments, it may harm aquatic plants and animals until it is diluted to a harmless level (Anonymous, 1999).

Chlorine can be bought either as a powder (calcium hypochlorite, usually 60–70 percent active ingredient), liquid (sodium hypochlorite, usually 7–10 percent active ingredient) or as tablets (sodium dichloroisocyanurate, usually > 90 percent active ingredient). Any of these forms of chlorine is effective and can be used depending upon price and availability. Normally a level of active chlorine in the water of 10–20 ppm for 12–24 h is sufficient to kill most viruses, bacteria and fungi (FAO, 2007).

The effect of chlorination at permissible levels, does not affect flora or fauna but excess amount of chlorine may harm aquatic plants and animals until it is diluted to a harmless level. Hence the knowledge of exact dosage to be applied needs to be ascertained and the effect of chlorination and the optimum dosage for maintaining the hatchery inlet water will depend on the water source and it is location specific. Hence this study was conducted with the main objective to determine optimum chlorine demand of hatchery water, complete residual time and effective chlorine dose required to disinfect the micro organisms and to investigate the effect of optimum dose of chlorine with the stocking density of shrimp larvae.

MATERIALS AND METHODS

Experimental design

A completely randomized design experiment was carried out with five active chlorine concentrations by adding calcium hypochlorite at 10, 20, 30, 40 and 50 ppm along with a control in triplicates (n = 3). Therefore, total 15 numbers of 50 lit FRP tanks with conical bottom have been used. Each chlorine solution of different concentrations was prepared by dissolving calcium hypochlorite and standardized with sodium thiosulphate (APHA, 1998). All tanks were aerated to maintain dissolved oxygen (DO) concentration above 5 ppm. The experiment was carried out outdoor of the shrimp hatchery under shaded condition for 24 h. Water quality parameters such as pH (pH-Scan-Eutech instruments, Singapore) and temperature (mercury thermometer) were analyzed at 3 h intervals from 0 h to 24 h of chlorine application.

Assessment of residual chlorine

When chlorine dissolves in pond water, it forms free residual chlorine. Part of this free chlorine which reacts with organic and inorganic substances and metals is referred as chlorine demand, and the residual parts oxidize and damage nucleic acid and/or protein of microorganisms and cause lethal damage (Acher *et al*., 1997; Chanratchakool, 1995). Concentrations of total residual chlorine (TRC) in treated water in each tank were analyzed in every 3h intervals after chlorine application. At each time interval, triplicate water samples were taken from each treatment. Total residual chlorine was analyzed by DPD titration method (APHA, 1998).

Assessment of microbial load

The total heterotrophic bacteria were determined in the shrimp rearing water by counting the colonies which grew on plates of Zobell Marine Agar (ZMA) (Hi-Media) with 1% of NaCl (Jorgensen *et al.*, 1993). Before plating each sample onto agar medium, serial dilutions were made in physiological saline (0.9 % NaCl) solution (Sohier and Bianchi, 1985). The bacterial counts were expressed in colony forming units per ml of water (CFU ml^{-1}) (Smith, 1998).

Experimental trial on *P. monodon* survival at different stocking density

Based on the previous trial the optimum chlorine dosage was determined and in that another experiment was carried out to observe survival of *P. monodon* larvae from PL5 to PL 20 in different stocking densities viz. 100, 125, 150, 175 and 200 no./L. The water quality was monitored and survival % was calculated at the end of the experiment. Survival % was analysed using following formulae:

Survival (%) = Shrimp no. at the end of experiment / Shrimp no. at the beginning of experiment × 100

RESULTS AND DISCUSSION

pH and temperature

The mean and standard error of pH and temperature are presented in Table 1 and 2 respectively. From the results it was observed that the first four treatments, pH of water get increased slightly while in 50 ppm concentration it raised rapidly. This increment was observed up to 9 hrs then it decreased gradually whereas in control, the value increased as time increase. When a chlorination product is applied to water, it dissolves and chlorine speciation takes place based on pH. At pH below 2, chlorine gas is dominant. Between pH 2 and 6, HOCl is the only type. As pH increases beyond 6, OCl appears. At a pH of about 7.5, HOCl and OCl^- occur in equal proportions, but at higher pH, OCl^- is the most abundant source of chlorine. When chlorine is added to water in any of these forms, it creates hypochlorous acid. Hypochlorous acid (HOCl) is a weak acid that dissociates into hypochlorite ion (OCl^-) according to the following equation:

$$HOCl \leftrightarrow H^+ + OCl^-$$

Free chlorine refers to both hypochlorous acid (HOCl) and the hypochlorite (OCl^-) ion or bleach, and is commonly added to water systems for disinfection. When ammonia or organic nitrogen is also present, chloramines

known as monochloramine, dichloramine, and trichloramine will quickly form. Chloramines are also known as combined chlorine. Total chlorine is the sum of free chlorine and combined chlorine. The level of total chlorine will always be higher than or equal to the level of free chlorine (Anon, 2011).

The two species exist in an equilibrium that is pH dependent. The equilibrium is also slightly affected by temperature. As the pH increases, the ratio of hypochlorous acid to hypochlorite ion decreases. Below a pH of 7.5, hypochlorous acid is the dominant species. Above a pH of 7.5, hypochlorite ion is the dominant species. The disassociation curve below illustrates the relationship between the chemical forms of chlorine and pH at 20° C. The graph indicates a significant change in the ratio of hypochlorous acid to hypochlorite between pH 6 and 9, within the typical pH range for drinking water treatment. The steepest portion of the curve is between pH 7 and 8. Even a 0.1 unit change in pH can cause a significant change in the ratio between HOCl and OCl^-. This is significant because HOCl is a stronger disinfectant than OCl^-. Therefore, the chlorination process is pH dependent. The germicidal effects of HOCl will be realized by chlorination at a lower pH.

The pH of chlorine is 11.7. It would seem logical that adding chlorine into water having a neutral pH would make the water more alkaline. When the pH of water is 7 or below, chlorine will act primarily as a sanitizer. At this level, it is very effective at killing bacteria. At 7.4, chlorine will act equally as a sanitizer and oxidizer. Above 7.8, the chlorine will act principally as an oxidizer. When chlorine is added to water it becomes hypochlorite ions (OCl) and hypochlorous acid (HOCl) in a quantity determined by the pH as indicated by the chart below:

pH	OCl	HOCI
6.0	3.50 %	96.50 %
6.5	10.00 %	90.00 %
7.0	27.50 %	72.50 %
7.5	50.00 %	50.00 %
8.0	78.50 %	21.50 %
8.5	90.00 %	10.00 %

The chart is helpful to work put the chlorine demand of hatchery water, complete residual time and effective chlorine dose required to disinfect the organisms, particularly pathogenic microorganisms and their carriers. The study indicated the percentage of OCl was higher compared to HOCl resulting the available chlorine in water as oxidizer. Besides, the higher the water temperature is, the lower the pH of water. Chunilall *et al*., 2002 reported that addition of hypochlorite in seawater treatments can lower the BOD and COD of the water and also improve the water quality. Temperature was found gradually decreased in all treatments which helped to maintain the pH slightly alkaline during the experimental period. In general hypochlorite are widely used as domestic disinfectant and sanitizing agent in food processing industry (WHO 2000) as well as inactivation of viruses in shrimp ponds and hatcheries (Boyd, 1996; Cai, 1994; Hedge *et al.*, 1996).

Table 1. pH in 3 hrs interval with different chlorine concentrations

	Control	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
0 hrs	7.40 ± 0.014	7.53 ± 0.018	7.49 ± 0.012	7.47 ± 0.0	7.48 ± 0.003	7.48 ± 0.003
3 hrs	7.62 ± 0.024	7.70 ± 0.003	7.77 ± 0.009	7.77 ± 0.012	7.93 ± 0.017	8.04 ± 0.009
6 hrs	7.73 ± 0.021	7.78 ± 0.003	7.86 ± 0.009	7.92 ± 0.009	7.98 ± 0.009	8.05 ± 0.009
9 hrs	7.78 ± 0.023	7.78 ± 0.023	7.82 ± 0.003	7.91 ± 0.017	7.93 ± 0.006	7.97 ± 0.007
12 hrs	7.75 ± 0.035		7.87 ± 0.012	7.86 ± 0.02	7.95 ± 0.009	8.00 ± 0.012
15 hrs	7.82 ± 0.012		7.88 ± 0.009	7.94 ± 0.023	7.95 ± 0.027	7.97 ± 0.003
18 hrs	7.84 ± 0.009		7.90 ± 0.007	7.94± 0.007	7.95 ± 0.003	7.98 ± 0.006
21 hrs	7.82 ± 0.025		7.88 ± 0.009	7.91 ± 0.006	7.93 ± 0.006	7.95 ± 0.003
24 hrs	7.85 ± 0.015				7.83 ± 0.018	7.89 ± 0.037

Table2. Temperature in 3 hrs interval with different chlorine concentrations

	Control	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
0 hrs	32.07 ± 0.233	31.8 0± 0.200	31.67 ± 0.318	31.53 ± 0.348	31.90 ± 0.058	31.83 ± 0.033
3hrs	31.33± 0.145	31.57 ± 0.033	31.10 ± 0.058	31.13 ± 0.033	29.13 ± 0.186	29.03 ± 0.133
6hrs	30.57 ± 0.067	30.47 ± 0.033	30.17 ± 0.088	29.87 ± 0.067	29.90 ± 0.100	29.80± 0.000
9hrs	26.80± 0.058	26.8 ± 0.058	27.13 ± 0.133	26.87 ± 0.033	26.97 ± 0.120	27.23 ± 0.088
12hrs	26.83 ± 0.033		27.10 ± 0.100	26.40 ± 0.058	26.63 ± 0.186	26.87 ± 0.033
15hrs	26.37 ± 0.088		26.77 ± 0.033	26.20 ± 0.058	26.33 ± 0.088	26.43 ± 0.067
18hrs	27.07 ± 0.033		27.07 ± 0.033	27.07 ± 0.033	27.07 ± 0.067	27.13 ± 0.088
21hrs	30.23 ± 0.033		29.90 ± 0.058	29.87 ± 0.033	29.70 ± 0.058	29.87 ± 0.033
24hrs	32.60 ± 0.100				32.80 ± 0.058	32.67 ± 0.033

Table3. Residual chlorine in different treatments

Stocking Density (nos/lit)		100	125	150	175	200
PL 5	Control	100.00	100.00	100.00	100.00	100.00
	Treatment	100.00	100.00	100.00	100.00	100.00
PL 10	Control	87.00	92.00	84.67	84.00	72.00
	Treatment	86.00	84.00	85.33	89.71	92.50
PL 15	Control	79.31	84.35	72.44	85.03	75.69
	Treatment	88.37	94.29	84.38	92.36	86.49
PL 20	Control	55.07	74.23	72.83	76.00	79.82
	Treatment	86.89	84.85	78.70	86.21	91.88

Table 4.Finalsurvival (%) of *P. monodon* larvae from PL 5 to PL 20

Hrs	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
3	0.10	0.2	0.3	0.4	0.5
6	0.05	0.1	0.2	0.3	0.4
9	0.00	0.1	0.2	0.3	0.4
12		0.1	0.2	0.3	0.4
15		0.1	0.2	0.3	0.4
18		0.1	0.2	0.3	0.4
21		0.0	0.0	0.0	0.2
24					0.0

Residual chlorine

Residual chlorine from 0 to 24h in all treatments is presented in Table 3. In 10 ppm, Residual chlorine has been found zero after 9 hours while in 50 ppm residual time was about 24 hrs. Although chlorination treatment of seawater is known to produce significant toxic effects on microalgae such as *Nitszchia closterium*, *Dunaliella tertiolecta*, and *Microcystsis* sp. (Stauber, 1998; Tsuzuki *et al.,* 1999), neutralization of hypochlorite ion using sodium thiosulfate allowed the growth of *Isochrysis galbana* with no negative effects. This species of microalga is one of the main food sources used in the culture of larval marine invertebrates (Reitan *et al.,* 1998; Fidalgo *et al.,* 1998). Since food cultures are a serious source of contamination in culture systems (Elston, 1989), control of bacterial numbers and types in these systems is of prime importance. Therefore, the dosage of chlorine must be in proper range to avoid such kind of problems. Our studies showed that at 10 ppm treatments was quickly eliminated from the water compared to other higher treatments. Besides, it was quite effective to disinfect the water which is discussed in the later section.

Bacterial load

Bacterial load was found nil in all treatments right from 10 ppm to 50 ppm except in control. Therefore, the minimum dosage i.e. 10 ppm was effective to control the bacterial load in water. Laboratory and field studies have demonstrated the biocidal effects of chlorine on certain viral (Frerichs, 1990; Inouye *et al.,* 1990), protozoan (Bedell, 1971; Sanders *et al.,* 1972) and bacterial (Sako *et al.,* 1988) pathogens of fish. Calcium hypochlorite at 200 ppm is commonly recommended for disinfection of hatchery equipment and ponds (Brown and Gratzek, 1980; Piper *et al.,* 1982) but in our studies a significantly lower dosage (10 ppm) of calcium hypochlorite found to be effective to disinfect the inlet water for hatchery at lesser retention time. Baticados and Pitogo (1990) also reported that chlorine dosage of 5 to 30 ppm in water for shrimp culture could minimize the bacterial load within 6 hours.

Larval survival at different stocking density

Final survival % of *P. monodon* larvae from PL 5 to PL 20 and overall survival in different stocking densities is illustrated in Table 4. Survival % of *P. monodon* larvae in all stages i.e. from PL 5 to PL 20 was higher in 10 ppm treated water compared to control. Besides, it was observed that overall survival % was more than 84 % in all stocking densities and also found > 90 % survival at 200 no/L stocking density for PL 5 to PL 20. Therefore, an intensive stocking density of P. monodon larvae can be reared after water treatment with 10 ppm calcium hypochlorite. Douillet and Pickering (1999) reported that survival of fish larvae (*Sciaenops ocellatus*) improved significantly by filtering the seawater through 1 μm filter, followed by chlorination at 5 ppm Cl^- for 2 h, and dechlorination with sodium thiosulfate. Survival of different larval stages of *P. monodon* was reported as more than 70 % in seawater treated with 20 ppm chlorine for 24 hours (Soundarapandian and Babu, 2010).

CONCLUSION

It could be concluded that chlorination is required at the optimum dosage of 10 ppm for ensuring better water quality in shrimp hatchery which is very much less when compared to the general dose which is followed to the range up to 30 ppm.Shrimp larvae can be stocked @ 100 no/L or even higher density in 10 ppm chlorinated water which offer higher survival rate in shrimp hatchery.

REFERENCES

Acher, A., Fischer, E., Turnheim, R. and Manor, Y.(1997).Ecologically friendly wastewater disinfection techniques. *Water Research*, **31**(6): 1398 – 1404. https://doi.org/10.1016/S0043-1354(96)00000-0

APHA.(1998). American Public Health Association.Standard methods for the examination of water and waste water, (20th edition) Eaton, A.D., Clesceri, L.S., Greenberg, A.E., Washington, DC.

Anonymous, (2011). Free vs. Total chlorine, Hach disinfection series 03. www.hach.com.

Anonymous, (1999). Chlorine effects on health and environment. 3rd edn.The Chlorine Institute, Washington, DC, 8 pp.

Arimoto, M., Sato, J., Maruyama, K., Mimura, G. and Furusawa, I. (1996). Effect of chemical and physical treatments on the inactivation of striped jack nervous necrosis virus (SJNNV).*Aquaculture*, 143, 15–22.

Baticados, M. C. L. and Pitogo, C. L. (1990). Chlorination of seawater used for shrimp culture. *The Israeli Journal of Aquaculture-Bamidgeh*, **42**(4): 128-130.

Bedell, G.W. (1971). Eradicating Ceratomyxa Shasta from infected water by chlorination and ultraviolet irradiation. *The Progressive Fish-culturist*, **33**: 5 l-54.

Boyd, C.E. (1996). Chlorination and water quality in aquaculture ponds.*World Aquaculture*, **27**: 41–45.

Brown, E.E. and Gratzek, J.B. (1980). Fish Farming Handbook. AVI Publishing Co., Inc. Westport, CN, 407 pp.

Bullock, G.L., Summerfelt, S.T., Noble, A.C., Weber, A.L., Durant, M.D. and Hankins, J.A. (1997). Ozonation of a recirculating rainbow trout culture system: I. Effects on bacterial gill disease and heterotrophic bacteria. *Aquaculture*,**158**: 43–55.

Cai, W. (1994). Fish disease. In: Li, S. and Mathias, J. (Eds.), Freshwater Fish Culture in China: Principles and Practice. Elsevier, Netherland, pp. 387–424.

Chang, P.S., Chen, L.J. and Wang, Y.-C. (1998). The effect of ultraviolet irradiation, heat pH, ozone, salinity and chemical disinfectants on the infectivity of white spot syndrome baculovirus. *Aquaculture*, **166**, 1 –17.

Chanratchakool, P., Pearson, M., Limsuwan, C. and Roberts, R.J. (1995). Oxytetracycline sensitivity of Vibrio species isolated from diseased black tiger shrimp, *Penaeusmonodon* Fabricius. *Journal of fish diseases*, **18**: 79 – 82. https://doi.org/10.1111/j.1365-2761.1995.tb01268.x

Chunilall, M., Govender and S. B. Jonnalagadda, (2002). Seawater in treatment of waste waters.*Journal of Environmental Science and Health, Part A: Toxic/ Hazardous Substances and Environmental Engineering*, **37**:8, 1523-1531, DOI: 10.1081/ESE-120013274

Douillet, P. A. and Pickering, P. L. (1999). Seawater treatment for larval culture of the fish *Sciaenops ocellatus* Linnaeus (red drum). *Aquaculture*, **170**: 113–126.https://doi.org/10.1016/S0044-8486(98)00398-6

Elston, R. (1989). Bacteriological methods for diseased shellfish In: B Austin and Da Ustin (eds) Methods for the Microbiological Examination of Fish and Shellfish. England: Ellis Horwood Ltd. pp 187-215

FAO. (2007). Improving *Penaeus monodon* hatchery practices. Manual based on experience in India. *FAO Fisheries Technical Paper,* No. 446. Rome, FAO. 101p.

Fidalgo, J.P., Cid, A., Torres, E., Sukenik, A. and Herrero, C. (1998). Effects of nitrogen source and growth phase on proximate biochemical composition, lipid classes and fatty acid profile of the marine microalga *Isochrysis galbana*. *Aquaculture,* **166**: 105– 116.

Frerichs, G.N. (1990). Efficacy of chemical disinfectants against snakehead rhadovirus.*Journal of Applied Ichthyology*,**6**: 117– 123.

Frerichs, G.N., Tweedie, A., Starkey, W.G. and Richards, R.H. (2000). Temperature, pH and electrolyte sensitivity, and heat, UV and disinfectant inactivation of sea bass (Dicentrarchus labrax) neuropathy nodavirus,*Aquaculture*,**185**: 13–24.

Hedge, A., Anthony, J. and Rao, S. (1996). Inactivation of viruses in aquaculture systems. *INFOFISH International*, **6**: 40–43.

Inouye, K., Ikeya, F., Yamazaki, T. and Hara, T. (1990). Virucidal activities of various germicidal to infectious pancreatic necrosis virus (IPNV). *Fish Pathology*, **25**: 81–86.

Jorgensen, N. O. G., Kroer, N., Coffin, R. B., Yang X. H. and Lee, C. (1993). Dissolved free amino acids, combined amino acids and DNA sources of carbon and nitrogen to marine bacteria. *Marine Ecology Progress Series*, **98**: 135-148.

Liltved, H. and Cripps, S.J. (1999).Removal of particle-associated bacteria by prefiltration and ultraviolet irradiation. *Aquaculture Research*, **30**: 445– 450.

Liltved, H., Hektoen, H. and Efraimsen, H. (1995). Inactivation of bacterial and viral fish pathogens by ozonation or UV irradiation in water of different salinity. *Aquaculture Engineering*, **14**: 107– 122.

Munro, P.D., Henderson, R.J., Barbour, A. and Birkbeck, T.H. (1999). Partial descontamination of rotifers with ultraviolet radiation: the effect of changes in the internal bacterial load and flora of rotifers on mortalities in start-feeding larval turbot. *Aquaculture*,**170**: 229– 244.

Pascho, R.J., Landolt, M.L. and Ongerth, J.E. (1995). Inactivation of *Renibacterium almoninarum* by free chlorine. *Aquaculture*, **131**: 65– 175.

Piper, R.G., McElwain, I.B., Orme, L.E., McCraren, J.P., Fowler, L.G. and Leonard, J.R. (1982). Fish Hatchery Management. Fish and Wildlife Service, U.S. Department of the Interior, Washington, DC., 539 pp.

Reilly, A. and Kaferstein, F. (1997). Food safety hazard and the application of the principles of the hazard analysis and critical control point (HACCP) system for their control in aquaculture production. *Aquaculture Research*, **28**: 735–752.

Reitan, K., Raimuzzo, J., Øie, G. and Olsen, Y. (1998). Nutritional effects of algal addition in first-feeding of turbot (*Scophthalmus maximus L.*) larvae. *Aquaculture*, **118**: 257– 275.

Sako, H., Yshida, N., Maeno, Y. and Sorimachi, M. (1988). Bactericidal activities of five disinfectants on Aeromonas salmonicida, Vibrio anguillarum, and V. ordalli. Fish Pathology,**23**: 219–229.

Sanders, J.E., Fryer, J.L., Leith, D.A. and Moore, K.D. (1972).Control of the infectious protozoan *Ceratomyxa Shasta* by treating hatchery water supplies. *The Progressive Fish-culturist*, **34**: 13-17.

Smith, P. T. (1998). Effect of removing accumulated sediments on the bacteriology of ponds used to culture *Penaeus monodon*. *Asian Fisheries Science*, **10**: 355-370.

Sohier, L.P. and Bianchi, M.A.G. (1985). Development of a heterotrophic bacterial community within a closed prawn aquaculture system. *Microbialecology*, **11:** 353–369.https://doi.org/10.1007/BF02016817

Soundarapandian, P. and Babu, R. R. (2010). Effect of Probiotics on the Hatchery Seed Production of Black Tiger Shrimp, *Penaeus monodon* (Fabricius). *International Journal of Animal and Veterinary Advances*, 2(1): 9-15.

Stauber, J.L., 1998. Toxicity of chlorate to marine microalgae. *Aquatic Toxicology*, **41**: 213– 227.

Tsuzuki, K., Tanaka, T., Takagi, T. and Shimomura, M. (1999). Effects of electrochemical treatment on Microcystis extinction.*Journal of Japan Society on Water Environment*, **22**: 228– 231.

Whipple, M.J. and Rohovec, J.S. (1994). The effects of heat and low pH on selected viral and bacterial fish pathogens. *Aquaculture*, **123**: 179–189.

White, G.C. (1992). The Handbook of Chlorination and Alternative Disinfectants, 3rd edn. Van Nostrand-Reinhold, New York.

WHO, (2000). Disinfectants and Disinfectant By-products. Environmental health criteria; 216, Geneva, 499p.

MICROSATELLITE ANALYSIS OF INDIGENOUS DUCKS OF ASSAM

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ABSTRACT

Indigenous duck breed of Assam are popular with considerable production potential with minimal input and mostly reared under semi intensive system of management. These ducks are maintained in all agro climatic zones of Assam and different from other indigenous duck genetic resources available in the country. But the genetic structure of these duck varieties was not fully studied; hence the genetic characterization of Assam ducks was assessed with 23 FAO recommended duck specific microsatellite markers using advanced automated genotyping technique. The analysis revealed that totally 91alleles were observed with the number ranging from 1 (CAUD025) to 7 (CAUD004 and APH009) and an overall mean of 3.957 ± 0.32 across the loci. The mean observed and expected heterozygosities were 0.4444 and 0.5113. All the microsatellite loci were found to be highly polymorphic except CAUD025. In Assam ducks, PIC value ranged from 0.14 (APH001) to 0.71 (CAUD004) with a mean value of 0. 4813. Nearly 14 out of 23 loci had PIC values of more than 0.5 indicating that these markers can be effectively used for genetic diversity analysis. The Chi-square test revealed that among the 23 microsatellite studied, only 12 were in Hardy-Weinberg equilibrium proportions and the rest departed from equilibrium. Selection and non-random mating could be the main reasons for this disequilibrium. The markers used in the study were found to be highly informative, explores high genetic variation in the population which could be exploited for their improvement.

Key Words: Assam Ducks, Microsatellite markers, Molecular characterization

INTRODUCTION

Indigenous ducks are evolved specifically to thrive well in the breeding tract with better adaptability and good productivity. Besides chicken production, duck farming especially small scale duck production makes a significant contribution to household economics and food security. Ducks are best maintained on free-range system because they are good foragers and it is mostly coincides with paddy cultivation. Ducks are best suited to integrate with paddy and fish farming. The leading states of India in duck population are West Bengal, Assam,

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Kerala, Andhra Pradesh, Tamil Nadu, Bihar and Orissa. The common Indian breeds/ genetic groups of ducks are Indian Runner, Nageswari, Sythetmete, Assam, Arni etc. Besides, non-descript ducks are also available in large numbers in many states of the country, contributing significantly to the total duck population. These indigenous ducks have innate potential to produce eggs and meat at considerable quantity with lesser input which are good dietary source of proteins.

In order to conserve available duck genetic resource, study on genetic diversity within and between duck populations using microsatellite markers would provide information for taking priority decisions towards preservation. According to FAO (2004) recommendations, using neutral, highly polymorphic microsatellite markers are currently the method of choice for genetic characterization and to provide information for establishing preservation priorities for livestock breeds. Microsatellite markers are widely used in genotype identification, pedigree analysis and estimation of genetic diversity and genetic distance (Romanov and Weigend, 2001; Chen *et al*., 2003; Yan *et al*., 2005). Molecular characterization and genetic diversity analysis by employing molecular tools is a pre-requisite in developing strategies for conservation and utilization of duck genetic resources for future generations. Therefore, the present study was undertaken to characterize the indigenous duck of Assam using the microsatellites.

MATERIALS AND METHODS

The indigenous duck of Assam are being reared popularly by all the duck farmers in Assam. They are the medium to large sized birds reared mainly for egg production. These ducks have different phenotypic characters as that of other indigenous ducks available in other parts of the country.

A total of 50 blood samples were collected at random from these birds in several areas of the main breeding tract were subjected to microsatellite analysis. Genomic DNA was extracted using standard Phenol-Chloroform extraction procedure (Sambrook *et al*., 1989) with slight modifications by using DNAzol reagent, instead of SDS and proteinase K.

PCR amplification and microsatellite analysis

A total of 23 microsatellite primer sets specific for ducks were used in the study as recommended by the Food and Agriculture Organization of United Nations, Rome, Italy (http://www.fao.org/dad-is). Only forward primers of each pair were labelled with one of the five fluorophore i.e. FAM, HEX, TET, FAT and PET and the reverse primers were kept unlabelled. These markers were amplified in the target DNA samples using thermal cycler (MJ Peltier). PCR reaction mixture (15µl) containing 1 µl of template DNA; 0.5 µl each of forward and reverse primers; 7.5 µl of PCR master mix and 5.5 µl of Millipore water was prepared. Amplification was carried out with initial denaturation at 95°C for 5 minutes; followed by 35 cycles of denaturation (95°C for 30 seconds), annealing (49.9°C to 60.0°C for 30 seconds for various primers) and extension (72°C for 5 minutes).

Amplified PCR products were checked on two per cent agarose gel and the bands developed were viewed by UV illumination (Bio-Rad, USA). The samples, which showed amplification were used for further study. The typing of microsatellite markers was made by capillary electrophoresis using automatic sequencer at Eurofins Genomics India Pvt. Ltd. Microsatellite fragment sizing was performed by the Gene MapperTm version 4.0 (Applied Bio-systems, Germany). The size standard (Gene Scan -500 ROX) peaks were used. Allele calling was performed with the software and were checked manually to avoid any false calling of alleles.

Number of alleles, effective number of alleles, Microsatellite allele frequencies, expected heterozygosity (He) and F-statistics were calculated by using POPGENE version 1.31 (Yeh *et al*., 1999).

RESULTS AND DISCUSSION

The allele number, polymorphism information content, observed and expected heterozygosity, Hardy Weinberg Equilibrium for different microsatellite loci for Assam ducks are presented in the Table.

Table.Microsatellite alleles, observed and expected heterozygosities, PIC, and Hardy-Weinberg equilibrium (HWE) values for *Assam* ducks

Microsatellite Marker	n_a	n_e	H_o	H_e	PIC	HWE	
						χ^2	d.f
CAUD010	4	1.1868	0.1111	0.1574	0.1560	35.03**	6
CAUD011	4	3.1765	0.1111	0.6852	0.6497	43.44**	6
CAUD013	6	3.4105	0.5556	0.7068	0.6949	66.88**	15
CAUD016	4	2.1672	0.2778	0.5386	0.5051	18.82**	6
CAUD017	2	1.8000	0.3333	0.4444	0.3457	1.42^{NS}	1
CAUD019	5	1.9343	0.5000	0.4830	0.4771	26.80**	10
CAUD022	3	2.2192	0.7778	0.5494	0.5259	6.70^{NS}	3
CAUD023	4	2.8297	0.4444	0.6466	0.6378	9.50^{NS}	6
CAUD024	4	2.4828	0.9444	0.5972	0.5939	13.52*	6
CAUD025	1	1.0000	0.0000	0.0000	0.0000	-	-
CAUD026	3	2.6667	0.8889	0.6250	0.5550	5.22^{NS}	3
CAUD027	4	2.1966	0.3889	0.5448	0.5418	5.87^{NS}	6
CAUD031	5	3.5217	0.8333	0.7160	0.6972	7.92^{NS}	10
CAUD032	5	2.0062	0.5000	0.5015	0.4566	4.67^{NS}	10
CAUD033	2	1.3144	0.0556	0.2392	0.2106	13.16**	1

CAUD035	4	2.2116	0.5000	0.5478	0.5368	8.96^{NS}	6
CAUD001	4	2.4089	0.6111	0.5849	0.5105	37.23**	6
CAUD004	7	3.4839	0.3889	0.7130	0.7109	73.43**	21
APH001	2	1.1803	0.1667	0.1528	0.1411	0.10^{NS}	1
APH007	5	2.8929	0.3889	0.6543	0.6366	14.12^{NS}	10
APH009	7	3.1610	0.2222	0.6836	0.6354	73.33**	21
APH010	2	1.9059	0.5556	0.4753	0.3624	0.36^{NS}	1
MCW328	4	2.0571	0.6667	0.5139	0.4887	4.07^{NS}	6
Mean	**3.957**	**2.3137**	**0.4444**	**0.5113**	**0.4813**	-	-
S. E.	**0.32**	**0.16**	**0.06**	**0.04**	**0.04**	-	-

n_a – observed number of alleles , n_e- Effective number of alleles, H_o- Observed heterozygosity, H_e- Expected heterozygosity, PIC- Polymorphism Information Content, χ^2- Chi- square value and d.f- Degrees of freedom .

NS- Not Significant *- Significant **- Highly significant

Microsatellite allelic diversity

In Assamducks the number of alleles ranged from 1 to 7 with mean number of alleles as 3.957 ± 0.32 across all 23 microsatellite loci.

The total number of alleles observed was 91. The lowest number of one allele was observed in CAUD025 and the highest number of seven alleles was observed in CAUD004 and APH009 locus. Higher number of total alleles than those observed in the present study was reported by earlier authors (236 alleles in 24 loci for six Chinese duck breeds by Li *et al*., 2006; 281 alleles in 20 loci among six Chinese duck populations by Wu *et al*., 2008). In contrast to this, lesser number of alleles were also reported by several authors (50 alleles in 21 primers for Moti Indian native ducks by Alyethodi and Kumar, 2010; 48 alleles in 9 loci among two Indian duck populations by Kumar *et al*., 2011).

The effective number of alleles was ranging from 1.1803 to 3.5217 with mean value of 2.3137 ± 0.16. Higher effective number of alleles than those in the present study was reported (4.80 and 3.60) by Li *et al*. (2006) and Kumar *et al*. (2011) respectively. The variations in the observed and expected number of alleles can be attributed to the genetic variability of the duck populations, number and type of microsatellite primers utilised for analysis and the difference within the duck population under study.

All the 23 microsatellite loci studied were highly polymorphic. This finding is in agreement with the reports of Li *et al*. (2006), Gaur *et al*. (2009), Su and Chen (2009), Alyethodi and Kumar (2010) and Kumar *et al*. (2011). The effective number

of alleles is also an index used to reveal the genetic diversity of duck populations and the highly polymorphic loci indicated that these microsatellite loci could be used as effective markers for molecular characterization and genetic diversity analysis among different duck breeds. Lower mean effective and observed number of alleles, obtained in the present study is the indicative of lesser frequencies of alleles, which might be due to closed nature of the populations.

Polymorphism information content

In general the polymorphism information content (PIC) values are suggestive of high polymorphic nature of the microsatellite loci analysed. The higher the PIC value the more informative a marker. The PIC is a good index for genetic diversity evaluation. When PIC is more than 0.5, the locus has high diversity; when PIC is less than 0.25, the locus has low diversity; and the locus has intermediate diversity when PIC is in between 0.25 and 0.5. The mean PIC value obtained in the present study was 0.4813 ± 0.04. As observed in the present study, Alyethodi and Kumar (2010) observed moderate PIC value in Moti ducks (0.45) with the same set of markers. Whereas, higher PIC value of more than 0.5 was observed at most of the loci in Chinese ducks (Li *et al*., 2006; Wu *et al*., 2008; Su and Chen, 2009) and Indian ducks by Kumar *et al*. (2011).

The differences in PIC of various microsatellite loci may be due to genetic differences in the population analysed. This indicated that the selected microsatellite loci had high diversity which can reflect the genetic relationship among different populations at molecular level and these loci are highly informative.

Heterozygosity

Genetic diversity can be measured as the amount of actual or potential heterozygosity. Heterozygosity is one of the indices used to assay the genetic variation of each population. The mean observed heterozygosity was 0.4444 ± 0.06 and the mean expected heterozygosity was 0.5113 ± 0.04. Among different loci analysed, the locus CAUD031 had the highest expected heterozygosity as 0.7160 and the locus CAUD025 had lowest value of 0.000 in Assam duck populations. Heterozygosity value of less than 0.6 was observed by Gaur *et al*. (2009), Alyethodi and Kumar (2010), Kumar *et al*. (2011) in various duck breeds. While mean heterozygosity value of more than 0.6 in Chinese and Indonesian ducks were reported by Li *et al*. (2006), Ying Su *et al*. (2007) and Wu *et al*. (2008) in different duck populations.

Generally, a marker to be considered useful for measuring genetic variation in a population should have a heterozygosity value of 0.3 to 0.8. Hence, the markers used in this study are quite suitable for assessing the genetic diversity in duck populations as the range of heterozygosity found in this study fit well within the specified range. This indicates that genetic diversity of this breed is high and there are enough gene resources in duck populations.

Hardy-Weinberg equilibrium

The results revealed that a total of 10 loci were found to depart from Hardy-Weinberg equilibrium proportions. In

general, 50 per cent of loci were not in Hardy-Weinberg equilibrium in the duck population. Similarly, in a study conducted by Wu *et al*. (2008), they reported that all the six Chinese duck populations were not in Hardy-Weinberg equilibrium. Among the Indian native ducks, Kumar *et al*. (2011) noticed that the Moti duck population was not in Hardy-Weinberg equilibrium while Indian Runner was in Hardy-Weinberg equilibrium for some markers (CAUD05, CAUD01, CAUD16 and CAUD35). The Hardy-Weinberg equilibrium was used in testing whether the genotypes were maintained in balance or deviated from balance. In this study, most of the loci were not in Hardy-Weinberg equilibria. This result showed that the population structure of this duck population have become unstable. Selection, non-random mating and inbreeding could be the main reasons which caused the disequilibria. In addition, other reasons such as the excursion caused by mutation, genetic drift, etc. could have caused the disequilibria, in the duck populations studied.

The current study revealed that the markers used were highly polymorphic with better heterozygosity and will be used to explore genetic variation in the population which could be exploited for their improvement. The high polymorphism of the markers indicates that they can be used effectively for genetic diversity and phylogenetic analyses of ducks. The high genetic diversity of the duck population could be exploited for improving productivity.

REFERENCES

Alyethodi, R.R. and Kumar, S. (2010). Genetic characterisation of Moti Indian native duck using microsatellite markers.*Journal of Applied Animal Research*,**38**: 223-227.

Chen, H.J., Yue,Y.S., Fan, X.Z., Zhang, C.S. and Du, L.X. (2003). Analysis of genetic diversity of Shandong indigenouschicken breeds using microsatellite markers. *Acta Genetica Sinica,* **30**: 855-860.

FAO (2004).Guidelines for Development of National Management of Farm Animal Genetic Resources Plans.*http://dad. fao.org/en/refer/library/ guidelin / marker.pdf*.

Gaur, U., Chaudhury, A., Tantia, M.S., Sharma, U., Javed, R. and Vijh, R.K. (2009). Molecular characterisation of Indian ducks (*Anas platyrhynchos*) populations using microsatellite markers. In: Proceedings of the IV World Waterfowl Conference, 11-13 November, 2009, Thrissur, Kerala, India. pp.117-130.

Kumar, S., Alyethodi, R.R., Sankhyan,V. and Kumar, S.S. (2011). Genetic comparison between Indian Runner and Moti native duck breeds. *Indian Veterinary Journal*, **88** (5): 36-39.

Li, H.F., Yang, N.,Chen, K.,Chen, G.,Tang, Q., Tu, Y.,Yu, Y. and Ma.Y. (2006). Study on molecular genetic diversity of native duck breeds in China. *World's Poultry Science Journal*, **62**: 603-611.

Romanov, M. N. and Weigend, S. (2001). Analysis of genetic relationships

between various populations of domestic and jungle fowl using microsatellite markers. *Poultry Science*, **80**: 1057-1063.

Sambrook, J., Fritsch E.F. and Maniatis, T. (1989). Molecular Cloning:A Laboratory manual 2nd edn. Cold Spring Harbour, Coldspring Laboratory Press, NY., ISBN-10: 9780879693091.

Su,Y. and Chen, G.H. (2009). DNA microsatellite analysis of genetic diversity amongChinese indigenous laying-type ducks (*Anas platyrhynchos*). *Czech Journal of Animal Science*, **54**: 128-135.

Wu, Y., Xiao-Lin, L., Shui-Sheng, H. and Wei Huang. (2008). Study on genetic diversity of six duck populations with microsatellite DNA. *The Asian-Australasian Journal of Animal Science*,**21**: 776-783.

Yan, F.H., Zuo, Zh. H., Chen, M., Song, Y.Q., Lu, L.J. and Chen. (2005). Analysis of genetic diversity and relationship among some Chinese domestic ducks and wild ducks using AFLP. *Journal of Xiamen University (Natural Science)*, **44**: 729-733.

Yeh, F.C., Boyle, T., Rongcai, Y.,Ye, Z. and Xian, J.M. (1999). Popgene, Version 1.31. A Microsoft Windows Based Freeware for Population Genetic Analysis. University of Alberta, Edmonton.

Ying Su., Ruijun Long, Guohong Chen, Xinsheng Wu, Kaizhou Xie and Jianghong Wan (2007). Genetic Analysis of Six Endangered Local Duck Populations in China Based on Microsatellite Markers. *Journal of Genetics and Genomics*, **34**:1010-1018.

A STUDY ON MIGRATORY PATTERN AND SOCIO-ECONOMIC STATUS OF TIRUCHY BLACK SHEEP IN TAMIL NADU

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ABSTRACT

Tiruchy Black is one of the coarse wool breeds of sheep reared in Tamil Nadu. An investigation was undertaken to ascertain the migratory pattern and socio-economic status of Tiruchy Black sheep at 71 flocks in 53 villages of Dharmapuri and Krishnagiri Districts of Tamil Nadu. The migratory tracts were almost regular over the year in the breeding tract. A total of eight migratory tracts comprising of three major and five minor tracts were identified. The overall distance covered was 98.64 ± 1.13 km with a range of 15 to 128 km. The mean radial migratory distance was 184.12 ± 1.42 with range from 65 to 234 in major tracts and 34.12 ± 1.62 with a range of 15 to 64 Km in minor tracts. The Tiruchy Black sheep farmers family size was comprised of 2-5 numbers and both the genders were involved in sheep rearing. In the present study, it was observed that vast majority of sheep farmers belonged to the most backward (72.16 %), followed by backward (22.37 %) and others (5.47 %). Majority of sheep farmers belonged to the 'Kurumba Gounders' (96.00%). A small proportion of them in small farms belonged to the Vanniyars (4.00%). Statistical analysis revealed no significant relation between caste, community and farm size. Depending upon the condition of the animal, prices of adult rams and ewes varied from Rs. 7,000 to 8,000 and from Rs.5000 to 6,000 respectively. Surplus ram lambs were sold at the age of 3 to 5 months for Rs.1,750 to 2,500. It is concluded that the Tiruchy Black sheep farmers were following traditionally migratory pattern over the generations and which helps improves their socio-economic status in the breeding tract of Tamil Nadu.

Key Words: Migratory pattern; Pastoralists, Sheep, Socio-economic status, Tiruchy Black

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INTRODUCTION

Livestock is one of the fastest growing agricultural subsectors in developing countries. Its share of agricultural GDP is already 33 per cent and production systems have both positive and negative effects on the natural resource base, public health, social equity and economic growth (Thornton, 2010). Currently, this growth is driven by the rapidly increasing demand for livestock products, this demand being driven by population growth, urbanization and increasing incomes in developing countries. Sheep with its multi-faceted utilities through meat, wool, skin and manure, form an important component of rural economy particularly in the arid, semi-arid and mountainous areas of the country(Ganesan *et al*., 2015). The sheep are distinct species among the domestic animals in the world since they have an excellent ability to survive over a prolonged period of drought and semi starvation and are less prone to extreme weather conditions. In the event of failure of seasonal rainfall in the rainfed area, leading to crop failure, sheep gives the farmers a helping hand and uplifts their livelihood in extreme climatic conditions (Swarnkar and Singh, 2010). Some sections of the people practice migratory sheep management as a way of life and have acquired caste/ community connotations as well, for example, the Raika community of Rajasthan and Gaddi community in Himachal Pradesh and Konar/ Yadhav community in Tamil Nadu (Kumaravelu, 2007). Also, the Kurumba Gounder *(Kumbers)* community preferred to rear Tiruchy Black sheep and hence this sheep is commonly called '*Karum kurumbai*'(Ganesakale and Rathnasabapathy,1973). On the other hand, the temporary migration is a coping strategy to farmers to the risk and uncertainties in the production system in the form of deficit rainfall and drought conditions which brings disturbance between the demand-supply equilibrium of the fodder (Suresh *et al*., 2011). Migratory production systems ensure sustainability and also are a major thrust to the narrowing genetic base of high performing animal breeds. Unfortunately, policy makers, conservationists and animal scientists have failed to recognize the importance of these longstanding human–animal–landscape associations for biodiversity conservation and for rural livelihoods (Rollefson *et al*., 2008). Thus, the aim of the present study was to collect the baseline comprehensive details of migratory pattern and socio-economic aspects of Tiruchy Black sheep farmers of Tamil Nadu.

MATERIALS AND METHODS

The survey was conducted on Tiruchy Black sheep breeding tract at Dharmapuri and Krishnagiri districts in North-Western agro-climatic zone of Tamil Nadu, India. The study was made in 53 selected villages and in each village flock structure, migratory pattern of the sheep and the socio-economic status of the shepherds were recorded. A total of 71 sheep flocks were selected randomly in the study location and divided based on the flock size as 1 to 20; 21 to 50; 51 to 75; 76 to 100 and above 100. The socio-economic factors like caste, community, literacy level, family type, age, migratory farming experience, land holding and type of land were included in the study. The desirable data were collected through

structured and pre-tested questionnaire. The questionnaires were filled on the spot by face-to-face interview with the sheep farmers. Based on the cost and returns, economics were calculated and presented. The data collected were scrutinized, collated and analysed by the conventional tabular analysis in the form of mean, standard error and percentage using the methods suggested by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Tiruchy Black sheep population in the breeding tract was estimated on the basis of the total sheep population from 53 villages of eight Panchayat Unions. The survey revealed that Tiruchy Black sheep population was approximately 9.35 per cent of the total sheep population in the breeding tract. During the survey the population was estimated to be approximately 19,509. The flock size and distribution of the sheep in various groups are presented in the Table 1.

The migratory tracts were almost regular over the year in the breeding tract. A total of eight migratory tracts comprising of three major and five minor tracts were identified. The overall distance covered was 98.64 ± 1.13 Km with the range of 15 to 128 Km. The mean radial migratory distance was 184.12 ± 1.42 with a range from 65 to 234 in major tracts and 34.12 ± 1.62 with a range of 15 to 64 Km in minor tracts. The migratory and radial distance covered by the flocks in a year is depicted in Figure 1.

Table 1: Per cent distribution of flock size of Tiruchy Black sheep in the breeding tract

Flock size	Tiruchy Black sheep flock (n= 71)
1 to 20	3.09 *(3)*
21 to 50	31.96 *(24)*
51 to 75	22.69 *(22)*
76 to 100	24.72*(16)*
>100	17.54 *(6)*

Figure 1. Migratory routes of Tiruchy Black sheep*

*** Major migratory routes**

1. Marandahalli to Marandahalli (Via Denkanikottai-Kelamangalam-Royakottai)
2. Krishnagiri to Nallampalli
3. Krishnagiri (Via Panchapalli dam and Chinnar dam) to Denkanikottai and return back

Minor migratory routes

4. Nallampalli to Nagavathi dam
5. Indur to Chekkodi
6. Periyampatti toThubalahalli dam
7. Krishnagiri to Gundrapalli
8. Pallapatti to Jarugu

Figure 2. Flocks of Tiruchy Black sheep in migration

The migratory flock owners preferred penning in Krishnagiri, Thali, Kelamangalam, Rayakottai of Krishnagiri district and Dharmapuri, Palacode and Nallampalli blocks of Dharmapuri district. Vast areas of coconut and mango farm gardens with no water logging uncultivated waste land, reserve forest and semi - rock terrains and water shed dams made it conducive to graze the sheep in these two districts. Afterwinter season, the flocks migrate from Marandahalli to Denkanikottai and few numbers of flocks move to water catchment area of Panchapalli watershed dam and Chinnar dam in Dharmapuri district during the summer.

Between mid-November and February, most of the sheep flocks migrated to Kaveripattinam to Nallampalli in Dharmapuri district, where there was great demand for penning and night folding of sheep in coconut and mango farm gardens and where the private fields remain harvested and provide good grazing resources. (Figure1 and 2). The migratory sheep flocks comprise of six to eight sheep owners with the total number of 300-400 sheep. The total sheep (300-400 sheep) were covered continuous eight day penning were sufficient to enrich the one acre land. During penning, the flock pastoralists were paid cash (at the rate of Rs. 1 per night) of sheep penned or two times food from the land owners. Apart from migration,

the shepherds had taken the flocks around seven kilometer radial distance throughout year. The seasonal variation of grazing hours was also observed in Tiruchy Black sheep flocks. The grazing hours during summer were started from 9.00 am and halt in the shadow area at 12.00 am. Then they were continued the grazing from 4.00 pm to 6.00 pm and return back. During rainy and winter season, the grazing hours were varied according to the spring and weather condition (10.00 am to 5.00 pm without any halt). This was similar to the earlier reports on Coimbatore sheep (Devendran *et al*., 2012; Kandasamy *et al*., 2006) and also the migratory sheep production system in Tamil Nadu reported by Singaravadivelan *et al*., (2019)

The socio-economic status based on family size, community, literacy level, land holding capacity of the Tiruchy Black sheep owners in the breeding tract are furnished in Table 2.

The family size comprised of 2-5 numbers and both the genders were involved in the sheep rearing. In all the categories of the shepherd community, vast majority of them were most backward (72.16 per cent), followed by backward (22.37%) and others (5.47%). The majority of them belonged to the 'Kurumba Gounders caste (96.00 per cent) while the rest belonged to the Vanniyar caste (4.00%). Statistical analysis showed no significant relation among caste, community and land holdings.

The results of the present findings coincide with that of Kandasamy *et al*., (2006), Tailor *et al*., (2006), Kumaravelu

Table 2: Socio-economic status of Tiruchy Black sheep owners

Social Parameters	Category	Average/Percentage
Family (number)		
	Family size	3.27 (2-5)
	Male	2.14 (1-4)
	Female	1.32 (0-2)
Community (%)		
	Backward	22.37
	Most backward	72.16
	others	5.47
Literacy rate (%)		
	Male	42.14
	Female	31.32
Land holding (%)		
	Landless	14.25
	Marginal<2.5 acres	71.25
	Small>2.5 to 5 acres	11.25
	Medium>5 to 20 acres	3.25

* Estimates from 71 flocks

(2007), Suresh *et al*., (2008) and Devendran *et al*., (2012), who had reported that sheep rearing was a traditional occupation for certain specific communities in different parts of Tamil Nadu. It was also observed that sheep rearing was a major occupation of socially backward classes and majority of the migratory sheep farmers belonged to the old age group (78 per cent), followed by the middle age (20 per cent) and young age group (2 per cent). Kumaravelu (2007) and Suresh *et al*. (2008) observed a similar trend with sheep farmers. The overall mean age of a sheep farmer was observed to be is 56.27 ± 1.87 years.Statistical analysis revealed no significant association between age group and flock size.

Since the flock owners wanted their children or youngsters of the family to opt for waged jobs in industries because of the state of Tamil Nadu is under rapid industrialization. The majority of the flock owners have made their sons and daughters educated in industrial training institutes, polytechnics and other colleges. This makes the educated youth to prefer the lucrative jobs than the traditional sheep rearing. Literacy level of the farmers was below 40 per cent which it leading to non adoption of new technologies in sheep rearing. Similar findings were reported by Tailor *et al*. (2006), Suresh *et al*. (2008) and Rajanna *et al*. (2012) with sheep farmers in different parts of India.

Ownership status of migratory sheep was absolute in 98 per cent of sheep, followed by sheep taken for lease (2 per cent). Similar findings were recorded by Kandasamy *et al*. (2006) and Kumaravelu (2007) in Coimbatore and Ramnad White sheep respectively in Tamil Nadu.

Majority of the sheep rearers were marginal farmers (71.25 per cent) followed by the landless (14.25 per cent) whereas, Thiruvenkadan *et al*. (2004) and Rajanna *et al*. (2012) found that the sheep framers were mostly small and marginal farmers. Also from the migratory sheep flock owners were not depend on agriculture for their main occupation was sheep rearing. The reduction in the size of land holdings is attributed to fragmentation of agricultural lands to the descendants of the farmers, sale of land for want of money, failure of seasonal rain, conversion of agricultural lands into residential and industrial plots, which has lead overall reduction of agricultural operations (Singaravadivelan *et al.,* 2019).

The cost and returns from migratory Tiruchy Black sheep are presented in Table .3

Table 3: Cost and returns from migratory Tiruchy Black sheep farming

Particulars	Amount(Rs)
Cost	
Deworming and Vaccination (Per sheep @ Rs 200)	14,800.00
Treatment and miscellaneous (Per sheep @ Rs 300)	22,200.00
Transport of lamb hut penning materials	5,000.00
Total cost per flock	**42,000.00**
Returns	
Sale of surplus lambs (Approximately 30.No. Lambs x Rs.4000 /annum	1,20,000.00
Sale of surplus adults (Approximately 7 lambs x Rs.6000)	42,000.00
Penning charges	15,000.00
Sale of manure	3,000.00
Total returns	1,80,000.00
Net returns per flock	1,38,000.00
Net returns per sheep	1864.66.00*

*Average flocks size (n=74)

The flock owners were involved in grazing the sheep and there is not involved the on wages and food for shepherds. The cost recurring for health management care (vaccination, deworming and treatment) and transportation of lamb hut, penning materials, etc. between migrations. The income from sheep farming was obtained mainly through sale of surplus lambs, culled adults, penning charges collected and sale of manure. In the study area, majority of the sheep flock owners penned their sheep in coconut and mango gardens, harvested rain-fed, irrigated agricultural fields during night. The sheep farmers charged at the rate of Rs.1.00 sheep/night from the owners of the agricultural fields in lieu of fertilization of the land by penning the sheep flocks. The penning sites were changed daily to an adjacent site for uniform enrichment of soil.

The ram at age group of 3 to 6 months were sold for growing and fattening at the rate of Rs. 2000 to 4000 per animal. Stocks at the age group of 5 to 7 months were in demand for meat purpose at the rate of Rs.7000 to 8000 per pair.

Culled rams and ewes were sold at about six year of age for Rs. 7,000-8,000 and Rs. 5000- 6000 per sheep respectively. The present findings were in agreement with Devendran *et al*. (2012) in migratory Coimbatore sheep flocks and Suresh *et al*. (2011), Swarnkar and Singh (2012) in Rajasthan. The overall average annual net returns per flock and per adult sheep estimated were Rs.1, 38,000 and Rs. 1,864.86 respectively, which is lower than the findings of Singaravadivelan *et al*. (2019) in migratory sheep flocks of Tamil Nadu, Rajapandi (2005) and Devendran *et al*. (2012) in migratory Coimbatore sheep

flocks and Prabhu *et al.* (2009) in Ramnad White sheep flocks in Tamil Nadu.

CONCLUSION

The results of the study revealed that majority of the Tiruchy Black sheep flock owners of Tamil Nadu were 'Kurumba Gounder's (96.00 per cent) community and belonged to an old age group (56 percent). The flock owners traditionally rear migratory sheep for many generations. Majority of the flock owners were marginal farmers followed by land less laborers. Theoverall average annual net returns per flock and per adult sheep estimated were Rs.1,38,000 and Rs. 1864.86 respectively. It is concluded that the Tiruchy Black sheep farmers followed the traditional migratory pattern over generations and it helps to improve their socio-economic status.

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REFERENCES

Devendran, P., Kandasamy, N., Panneerselvam, S. and Selvam, S. (2012). Economic analysis Coimbatore sheep rearing. *Indian Journal of Small Ruminants*,**18**(1): 239-243.

Ganesakale.D. and Rathnasabapathy, V. (1973). Sheep breeds of Tamil Nadu. *Cheiron*, **2**: 146-155.

Ganesan, R., Dhanavanthan, P., Balasubramanyam, D., Kumarasamy, P. and Kiruthika (2015). Growth modeling and factors affecting growth traits in Madras red Sheep. *Indian Journal of Animal Research*, **49**: 20-25.

Kandasamy, N., Paneerselvam, S., Devendran, P. and Thiruvenkadan, A.K. (2006). Final report on survey evaluation and characterization of Coimbatore sheep breed. Department of Animal Genetics and Breeding, Veterinary College and Research Institute, Namakkal, Tamil Nadu, India.

Kumaravelu, N. (2007). Analysis of sheep production system in southern and northeastern zone of Tamil Nadu. Ph.D., Thesis submitted to Tamil Nadu Veterinary and Animal Sciences University, Chennai-600 051.

Prabhu, M., Selvakumar, K.N., Serma Saravana Pandian, A. and Meganathan, N. (2009). Economic analysis of sheep farming in Tamil Nadu. *Indian Journal of Small Ruminants*, **15**(2): 224-230.

Rajanna, N., Mahendar, M., Thammpi Raju, D., Raghunandan, T., Nagalashmi, D. and Sreenivasa Rao, D. (2012). Socio-economic status and flock management practices of sheep farmers in Telangana region of Andhra Pradesh. *Veterinary Research*, **5**: 37-40.

Rajapandi, S. (2005). Distribution and management practices of Coimbatore sheep. M.V.Sc., Thesis submitted to Tamil Nadu Veterinary and Animal Sciences University, Chennai-600 051.

Rollefson, I.K., Rathore, H. S. and Mathias. E. (2008). Local breeds, livelihoods

and livestock keepers' rights in South Asia. *Tropical Animal Health and Production,* **41**(7):1061-70.

Singaravadivelan, A., Kumaravelu, N., Vijayakumar, P. and Sivakumar, T. (2019). An economic analysis of migratory sheep production system in Tamil Nadu, India. *Journal of Animal Health and Production,* **7**: 58-64.

Snedecor, G.W. and Cochran, W.G. 1994. Statistical Methods. 8th edn. Oxford and IBH Publishing Company, Kolkata, India.

Suresh, A., Gupta, D.C. and Mann, J.S. (2008). Farmers management practices and economics of sheep rearing on eastern semiarid region of Rajasthan. *Indian Journal of Small Ruminants,* **14**(1): 236- 242.

Suresh, A., Gupta, D.C. and Mann, J.S. (2011). Trends, Determinants and Constraints of Temporary Sheep Migration in Rajasthan- An Economic Analysis.*Agricultural Economics Research Review*, **24**: 255-265.

Swarnkar, C.P. and Singh, D. (2010). Questionnaire survey on sheep husbandry and worm management practices adopted by farmers in Rajasthan. *Indian Journal of Small Ruminants,***16**(2): 199- 209.

Tailor, S.P., Nagda, R.K. and Gupta, L. (2006). Characterization and evaluation of Sonadi sheep in its native tract. *Indian Journal of Small Ruminants,***12**(2): 206-211.

Thiruvenkadan, A.K., Karunanithi, K. and Purushothaman, M.R. (2004).Socio-economic status of the Mecheri sheep farmers and economics rearing under farmer's management.*Indian Journal of Small Ruminants*, **10**(2): 117-122.

Thornton, P.K. (2010). Livestock production: recent trends, future prospects. *Philosophical Transactions of the Royal Society Bulletin*, **365**:2853-2867.

SYNTHESIS AND CHARACTERIZATION OF SELENIUM NANO PARTICLES BY HIGH ENERGY BALL MILLING (HEBM) TECHNIQUE

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ABSTRACT

In present day, supplementation of extra minerals and vitamins is highly essential in commercial diets due to high productivity and to withstand the detrimental effects of different stresses. Selenium is one of essential trace minerals for better growth and productivity as well as anti-stressor in commercial broilers. Nano-selenium can effectively be synthesized through High Energy Ball Milling (HEBM) technique from its precursor, for use in commercial broilers as anti-stressor and to support multiple bodily functions. The prepared nano particle had 44.5 % of selenium as measured by Energy Dispersive X-ray (EDAX) analysis with the product yield of 50 g/hr. The chemical composition of sodium selenite powder was same as that of the original mega particle. The size of Se nano particle ranged from 37-85 nm as analyzed through Field Emission Scanning Electron Microscope (FESEM). X-Ray diffraction pattern confirmed that the synthesized Se nano particle was free of impurities and provided accurate information on the atomic arrangements. The Fourier Transform Infra-Red (FTIR) spectrum of synthesized nano particle source of selenium peaks was located at 3023.26, 2800.12, 2502.23, 2314.17, 1610.40 and 1413.30 cm-1 which showed chemical bonding in a target material. The zeta potential of nano selenium was -23.30 mV when analyzed through particle size analyzer. Se nano-particles could be successfully synthesized through High Energy Ball Milling method from its precursor and could be characterized for its quantity, size, shape, stability and purity. The synthesized Se nano-particles could be utilized for the conduct of biological trial in commercial broilers.

Key Words: Concentration, Nano Se, Particle Size Purity, and Zeta potential

INTRODUCTION

The faster industrialization and improved productivity of recent day commercial poultry, obviously face several constraints in production and productivity in the arena of global warming. Hot environment will substantially reduce productivity of poultry especially broilers. Supplementation of minerals and vitamins are highly essential to overcome the deleterious effects of hot environment and to maintain better production potential with proper immunity.

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Recently trace minerals in the form of nano-particles are effectively used to fulfill the requirement of minerals in the poultry diets. The extreme smaller sized nano particles has unique physical properties and different when compared to their conventional forms. Nano form of supplementation increases the surface area and leads to increased rate of absorption and utilization of minerals resulting in reduction of required quantity and feed cost. Selenium is one of the essential minerals required for optimal growth and productivity by supporting multiple functions related to poultry production, fertility and disease prevention.

With the recent development of nanotechnology, nano-selenium (nano-Se) has attracted widespread attention because nanometer particulates exhibit novel characteristics such as large surface area, high surface activity, high catalytic efficiency, strong adsorbing ability and low toxicity (Wang *et al*., 2007; Zhang *et al*., 2008). This nano-selenium has to be synthesized by simple and efficient technology for use in commercial poultry as anti-stressor or productivity enhancer. Hence, the present study was undertaken to synthesize and characterize selenium nano particles through High Energy Ball Milling (HEBM) technique compared to other conventional methods for utilization in biological trial with commercial broilers.

MATERIALS AND METHODS

Synthesis of nano-selenium

High Energy Ball Milling (HEBM) technique was adopted to prepare nano particle source of selenium. Nano particle source of selenium was synthesized by grinding feed grade sodium selenite in a ball mill (8000D Mixer/Mill – Dual High Energy Ball Mill) @ 1060 cycles/min using two 12.7 mm stainless steel ball in each jar of 75 ml capacity for 60 mins (Munoz *et al*., 2007). The percentage of selenium present in prepared nano particle was measured by Energy Dispersive x-ray analysis (EDAX) following the protocol outlined by Russ (1970).

Characterization of nano-selenium

The size of the synthesized selenium nano particle was determined by adopting the procedure demonstrated by Yao and Kimura, (2007) using Field Emission Scanning Electron Microscope (FESEM). The prepared nano particle cold source was employed and was placed on a carbon coated Cu grid and examined using an FE-SEM (Carl Zeiss SUPRA-55).

Structural aspects of prepared selenium nano particle were determined by X-Ray Diffraction technique using Rigaku Mini Flex-II Desktop X-Ray Diffractometer as per the protocol explained by Theivasanthi and Alagar (2010).

The surface chemistry and functional group of the synthesized selenium nano particle was investigated by Fourier Transform Infra-Red (FTIR) spectroscopy (Agilent Model Cary 630) according to the method of Chattopadhyay *et al*. (2014).

Zeta potential (mV) of the prepared nano particle was determined based on the principle of photon correlation spectroscopy using Particle Size Analyzer (HORIBA Scientific nano partica SZ-100).

RESULTS AND DISCUSSION

The product yield, particle size, zeta potential, mineral content of nano particle of selenium produced by high energy ball milling are presented in Table 1. The percentage of selenium was 44.5 per cent in prepared nano particle as measured by Energy Dispersive X-ray (EDAX) analysis. The product yield of nano particle source of selenium produced by physical method using ball mill was 50 g/hr. Nano Se particles were successfully produced by using High Energy Ball Milling technique through physical method of synthesis. Similarly, McCormick and Froes, (1998) produced large quantity of nano-particles with low production cost by using mechanical milling technique. High Energy Ball Milling technique is the simple and inexpensive method of production of nano-particles of different materials as stated by El-Eskandarany, (2001). The same technique was also adopted to produce iron and zinc nano-particles by Munoz, (2007) and Salah *et al*. (2011) respectively with sufficient quantity to obtain ideal size of nano-particles. Hence, High energy ball milling is one of the physical methods in synthesis of nano-particles with various shapes and dimensionalities with low production cost. Based on the milling time, the structural and chemical reactions occurred in the minerals and the force applied during milling leads to fracture of the particles which resulted in required quantity and quality of nano-particles.

The size of Se nano particle analyzed through Field Emission Scanning Electron Microscope (FESEM) was less than 100 nm. The FESEM image of produced nano particle source of selenium was determined between the sizes ranged from 37-85 nm (Fig. 1). Similarly, Yao and Kimura, (2007) mentioned FESEM is a useful tool for high resolution surface imaging in the field of nanomaterial sciences for magnification of gold nano-particles. Silver nano-particles with the size of 10 and 25 nm had been measured successfully by Kaviya *et al*. (2011). FESEM might be the well-defined technique to study the size and shape in 3D nano-particles superlattices due to its higher resolution when Field Emission source is combined with Scanning Electron Microscope.

Table 1 Characterization of nano particle source of selenium

S. No.	Characterization parameters	
1	Chemical name of source	Sodium selenite
2	Mean product yield (g/hr)	50
3	Size (assessed through FESEM) nm*	37-85
4	Zeta potential (mV) *	-23.30
5	Selenium content assessed through EDAX (%)*	44.5

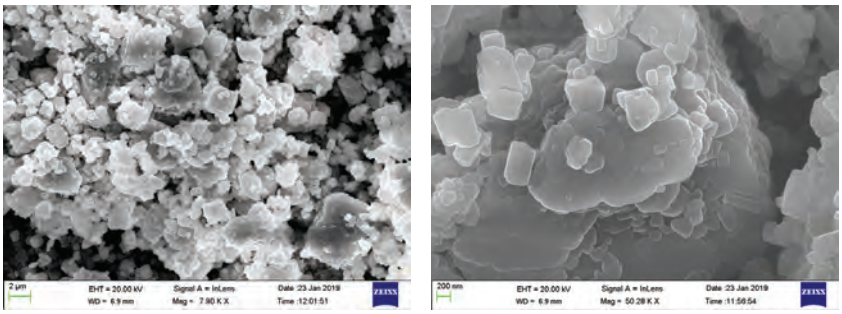

Fig. 1 Field Emission Scanning Electron Microscope (FESEM) image of synthesized nano particle source of selenium

The X-Ray diffraction (XRD) pattern of synthesized nano particle source of selenium is shown in Fig. 2. The data recorded in the 2θ was analyzed using Jade 6.0 software. X-Ray diffraction pattern confirmed that the synthesized Se nano particle was free of impurities as it did not contain any characteristic XRD peaks other than selenium peak and the samples were nano in nature. The same analysis was conducted by Sharma *et al*. (2012) for crystallographic characteristics of bulk nano and thin film material to study the structural dimension of nano-particles. Similarly, Yadav and Bajpai, (2017) obtained the XRD pattern of nano powder synthesized at pH 9.5 with pure CuS phase without any impurity. The intensities based on XRD pattern confirmed that the synthesized Se nano-particles were free from impurities and provided accurate information on the atomic arrangements.

The typical FTIR spectrum of synthesized nano particle source of selenium peaks was mainly located at 3023.26, 2800.12, 2502.23, 2314.17, 1610.40 and 1413.30 cm^{-1}. The shift in peak from 3023.26 to 2800.12 cm^{-1}corresponded to OH/C-C bending which might be responsible for reduction. The functional groups of synthesized Se nano-particles were analyzed by Fourier Transform Infra-Red (FTIR) spectroscopy which showed

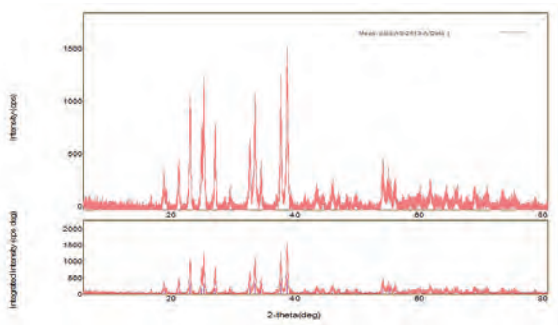

Fig. 2. X-Ray diffraction (XRD) pattern of synthesized nano particle source of selenium

chemical bonding in a target material. In accordance with this Yao and Kimura (2007) stated that FTIR was effectively utilized to study the functional group of gold nano-particles. Similarly Baudot *et al.* (2010) unveiled the identity of functional group of Carbon nano-particles through FTIR and suggested that FTIR is the best tool to study the chemical bonding of nano-particles. Kaviya *et al.* (2011) observed the shift in the absorption band after bio-reduction at 1601cm^{-1} to 1584 cm^{-1} and indicated the formation of nano-particles. The appearance of this peak was due to the presence of hydroxyl group stretching vibration of phenolic compounds which was responsible for the formation and stabilization of synthesized nano-particles.

The chemical composition of sodium selenite powder was analyzed by Energy Dispersive X-Ray (EDAX) analysis and shown in Fig. 3. This confirmed the presence of 44.5 per cent selenium content which was same as that of the original mega particle. Aparna and Karunakaran (2014) produced nano selenium powder with 94.69 per cent selenium content from 99 per cent pure selenium powder. Similarly Arulnathan *et al*. (2016) produced nano selenium with 98.57 per cent selenium from 99 per cent pure selenium powder. However, Jimeno-Romero *et al*. (2016) stated that the chemical composition of nano-particles depended on size and biological effects. They obtained accurate Se content of nano-particles through HEBM method and resulted in no loss of minerals. The accuracy of selenium content was mainly due to nano-particles size and biological effects that gave a clear picture about a cellular structures present in the nano-particles.

The zeta potential of nano selenium synthesized in this study was -23.30 mV when analyzed through particle size analyzer. Zeta potential is an important parameter to study the stability of nano-particles. The zeta potential of +30 to -30 mV considered to have high degree of stability was suggested by Xu (2008) and Clogston and Patri (2011) in anionic and cationic nano-particles. Similar to the result of this study, Nanocomposix, (2012) also suggested zeta potential of -25 to +25 mV had high degree of stability. The Se nano-particles produced in this study had high degree of stability due to Van Der Waal Inter-particle attractions as suggested by Nanocomposix, (2012).

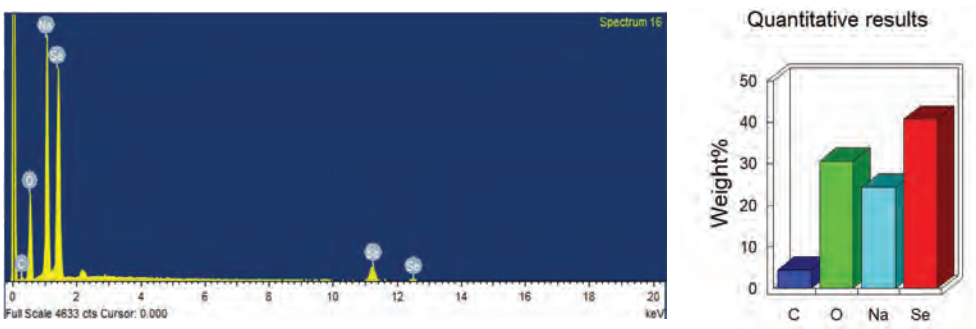

Fig. 3. EDAX spectrum of Se nanoparticles

Se nano-particles could be successfully and effectively synthesized through High Energy Ball Milling method from its precursor and the same could be characterized for its quantity, size, shape, stability and purity. The synthesized Se nano-particles could be utilized for the conduct of biological trail in commercial broilers.

REFERENCES

Aparna, N. and Karunakaran, R. (2014). Effect of selenium nanoparticles supplementation on oxidation resistance of broiler chicken.*Indian Journal of Science and Technology*, **9** (S1): 1-5.

Arulnathan, N., Karunakaran, R., Balakrishnan, V., Chellapandian, M. and Geetha, K. (2016). Synthesis and characterization of nano selenium as feed supplement, *International Journal of Science Environment Technol*ogy, **5** (4): 2296-2300.

Baudot, C., Tan, C.M. and Kong, J.C. (2010). FTIR spectroscopy as a tool for nano-material characterization. *Infrared Physics & Technology*, **53**: 434–438.

Chattopadhyay, S., Dash, S.K., Tripathy, S., Das, B., Mandal, D., Pramanik, P and Roy, S. (2014). Toxicity of cobalt oxide nanoparticles to normal cells; an in vitro and in vivo study.*Chemico-Biological Interact*ions, **226**: 58-71.

Clogston, J. D. and Patri, A.K. (2011). Zeta potential measurement.*Methods in MolecularBiology,* **697**: 63-70.

El-Eskandarany, M.S. (2001). Mechanical alloying for fabrication of advanced engineering materials. Norwich, New York, William Andrew Publishing.

Jimeno-Romero A, Oron, M., Cajaraville, M. P., Soto, M. and Marigomez, I. (2016). Nanoparticle size and combined toxicity of TiO2 and DSLS (surfactant) contribute to lysosomal responses in digestive cells of mussels exposed to TiO2 nanoparticles. *Nanotoxicology*, **10** (8):1168-76.

Kaviya, S., Santhanalakshmi, J., Viswanathan, B., Muthumary, J. and Srinivasan, K. (2011). Biosynthesis of silver nanoparticles using citrus sinensis peel extract and itsantibacterial activity. *Spectrochimica ActaPart A*,**79**: 594–598.

McCormick and Froes, F.H. (1998). The fundamentals of mechano chemical processing, **50** (11):61-65.

Munoz, J.E., Cervantes, J., Esparza, R. and Rosas, G. (2007). Iron nanoparticles produced by high-energy ball milling. *Journal of Nanoparticle Research*, **9**: 945–950.

Russ, J.C., (1970). Energy dispersion X-Ray Analysis on the Scanning Electron Microscope, American Society for Testing and Materials, Phialdelphia, 154-17.

Salah, N., Habib, S.S., Khan, Z.H., Memic, A., Azam, A., Alarfaj, E., Zahed, N and Hamedi, S.A. (2011). High-energy ball milling technique for ZnO nanoparticles as antibacterial material.*International Journal of Nanomedicine*, **6**: 863–869.

Sharma, R., Bisen, D.P., Shukla, U. and Sharma, B.G. (2012). X-ray diffraction: a powerful method of characterizing nanomaterials. *Recent Research in Science and Technology*, **4**(8): 77-79.

Theivasanthi, T. and Alagar, M. (2010). X-Ray Diffraction studies of copper nanopowder. *Archives of Physics Research*, **1** (2): 112-117.

Wang, H. L., Zhang J. S. and. Yu, H. Q. (2007). Elemental selenium at nano size possesses lower toxicity without compromising the fundamental effect on selenoenzymes: Comparison with selenomethionine in mice. *Free Radical Biology & Medicine*, **42**: 1524–1533.

Xu, R., (2008). Progress in nanoparticles characterization: Sizing and zeta potential measurement. *Particuology*,**6**: 112–115.

Yadav, S. and Bajpai, P.K. (2017). Synthesis of copper sulfide nanoparticles: pH dependent phase stabilization. *Nano-Structures & Nano-Objects*, **10**:151-158.

Yao, H. and Kimura, K. (2007).Field emission scanning electron microscopy for structural characterization of 3D gold nanoparticle superlattices. In: Eds. Méndez-Vilas, A and Diaz, J. Modern research and educational topics in microscopy, Badajoz, Spain : Formatex, pp.568-575.

Zhang, J.S., Wang, X.F. and Xu, T.W. (2008). Elemental selenium at nano size (nano-Se) as a potential chemopreventive agent with reduced risk of selenium toxicity: Comparison with Se-methylselenocysteine in mice. *Toxicological Sciences*, 101: 22–31.

Short Communication

'OESTRUS MONITORING CHART': A TOOL TO IMPROVE POST BREEDING OESTRUS OBSERVATION IN A DAIRY FARM

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ABSTRACT

Oestrus detection plays an important role in the reproductive management of a dairy farm. To improve the post-breeding oestrus observation practice among the farmers, a reproductive management tool called 'Oestrus Monitoring Chart' (OMC) was designed and developed. The effectiveness of this technology on oestrus detection, timed artificial insemination and pregnancy diagnosis was studied in a small scale crossbred cattle dairy farm. Breeding parameters viz., number of inseminations carried out per animal, duration between two successive inseminations for each animal, duration between artificial insemination and pregnancy check-up and conception rate was studied for a period of one year before (G1) and one year after installation of OMC (G2). Perusal of the data revealed that the duration between successive artificial insemination (AI) and the duration between AI and pregnancy diagnosis was significantly ($P < 0.01$) decreased in G2 group when compared with G1 group. The conception rate was also significantly improved after the installation of the OMC and introduction of OMC as a reproductive management tool improved the oestrus detection attitude among the farm personnel.

Key Words: Dairy farm, 'Oestrus monitoring Chart', Oestrus detection, Pregnancy diagnosis

INTRODUCTION

Detection of behavioural oestrus continues to play an important role in the overall reproductive management program in a dairy farm. Variations in the duration and intensity of oestrus warrant the need for accurate and continuous monitoring

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to determine the optimal breeding time. The low accuracy and efficiency of oestrus detection not only increases time from calving to first AI but also increases the average interval between services (Stevenson and Call, 1983), thereby limiting the pregnancy rate. Automated technologies which provide continuous surveillance of physical activity of the cattle have been developed and utilised by large scale dairy units (Fricke *et al*., 2014; Mayo *et al*., 2019) to enhance detection of oestrus. However these technologies are not user friendly for small scale dairy farmers in both technical and economical means.

Visual observation of behavioural oestrus signs is the cheapest and effective method of detecting oestrus in cattle but farmers are generally lacking the practice of maintaining breeding records and also fail to follow-up the return or non-return to oestrus post breeding, which leads to delay in pregnancy diagnosis and ultimate failure of reproductive management in any dairy farm. In order to improve the post-breeding oestrus observation practice among the farmers, a reproductive management tool called 'Oestrus Monitoring Chart' was designed and developed jointly by the Department of Veterinary Gynaecology and Obstetrics and Department of Veterinary and Animal Husbandry Extension Education of Veterinary College and Research Institute, Tirunelveli, Tamil Nadu, India. This paper will focus on the effectiveness of this OMC as a tool for oestrus detection post breeding, timed AI and pregnancy diagnosis in a small scale dairy farm.

MATERIALS AND METHODS

A small scale organized dairy farm of crossbred cattle located at Tirunelveli with proper breeding registers was selected for the study.

Development of 'Oestrus Monitoring Chart'

The design of the 'Oestrus Monitoring Chart (OMC)' is given in Fig.1. The base of the wall mount unit is a white marker acrylic board (24" x 48"). On the right half of the board, a pair of circular plastic plates is fixed one over the other. The lower larger diameter plate is engraved with dates for two months around the periphery (1 – 31 and 31 – 1) and is freely rotatable using a small knob. The smaller diameter plate was fixed over the larger plate and is static with two rectangular slits (one small and one larger). Single date (*i.e*., date of AI) can be viewed through the small slit while the larger slit was distanced from small slit in such a way that four dates *i.e*., days 18, 19, 20, 21 after the date of AI could be visualised. The left half of the board consists of a tabular column with the provision for manual entry of the details of animal number, date of AI and the dates during which period the animal should be observed for oestrus post AI (Fig. 2). Seven rows are available, thus details of 7 animals can be recorded at a time.

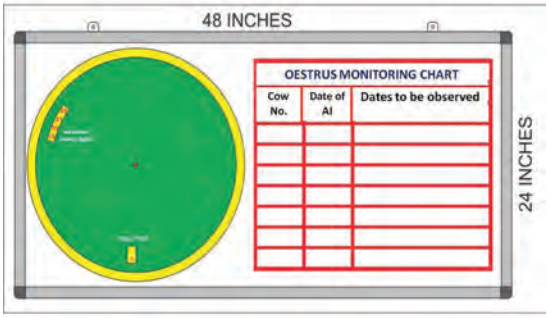

Fig 1: Basic structure of wall mount 'Oestrus Monitoring Chart'

Fig 2: Recording of day- to- day data in Oestrus Monitoring Chart

Operating procedure of the Chart

The OMC was installed in the cattle shed with easy accessibility and visibility of the farm in-charge / labourers. Initially the date of AI along with the animal identity number should be recorded on the chart at the specified columns. By placing the date of AI underneath the small slit of static wheel, the four dates viewed in the larger slit should be recorded in the specific row adjacent to the pertaining animal. Every day the farm in-charge/ labourer have to peruse the details in the OMC and check the particular animal mentioned in the concerned dates for the behavioural changes and external symptoms (discharge, vaginal etc.) correlating with oestrus. If the animal exhibited oestrus signs during the period of observation it should be subjected for gynaeco-clinical examination and insemination be performed. If no oestrus was exhibited it should be checked for pregnancy within 45 – 60 days post AI.

Experimental design to study the efficacy of the chart

As a control study, breeding parameters of 12 breedable adult crossbred cattle (cows: 8 andheifers: 4) were studied for a period of one year (January 2018 to December 2018). Based on the breeding register, the following parameters were recorded (i) number of inseminations carried out per animal ii) duration between two successive inseminations for each animal iii) duration between AI and pregnancy check-up and iv) number of animals conceived. The mean values were arrived for the first three

parameters and conception rate (%) was arrived for the fourth parameter. After the control study, the OMC was installed in the farm and the above parameters were studied for the next one year (January 2019 to December 2019) with the breedable adult stock of 14 animals (cows:8 and heifers: 6). The operation of OMC was managed by a single operator during the entire experimental period and two sets of data viz., pre-installation (G1) and post-installation (G2) of OMC were obtained.

Statistical analysis

The pre-installation and post-installation data were statistically analysed for significance using simple Student's t-test as described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The pre-installation and post-installation data of the parameters were represented in Table 1. Perusal of the data revealed that the duration between successive AI was significantly decreased in G2 group when compared with G1 group. The finding indicated the improvement in the post-breeding oestrus monitoring pattern among the farm personnel after the installation of the OMC, which would have motivated them to inseminate the animal in the subsequent oestrus. It is mandatory that the dairy farmers need to recognize non-pregnancy at the earliest so as to rebreed the animal at the very next cycle. Baruselli *et al*., (2017) stated the importance of reducing the interval between two consecutive AI and attributed the same to the reduction in the interval between two subsequent calvings.

It was found that the pregnancy of the animals was checked significantly earlier in G2 group (46.7 $\pm$ 2.7 days) than G1 group (123.0 $\pm$ 18.7days) which indicated that observance of non-return to cycle improved the alertness among the farm personnel for diagnosing pregnancy at an earlier date. It was reported that the farmers would incur a loss of around INR 300 – 400 per day due to one day increase in open period due to delay in pregnancy diagnosis (Abdullah *et al*., 2014). Even though economic calculations were not carried out in the study, based on the previous reports it could be concluded that introduction of the OMC as a tool definitely improved the basic economic turnover of the farm.

Table 1: Breeding parameters of crossbred cattle pre- and post- installation of 'Oestrus Monitoring Chart'

S.No	Treatment group	No. of animals (breedable stock)	Mean no. of AI/ animal	Mean duration between two successive AI (days)	Mean duration between last AI and pregnancy check-up (days)	Conception rate (%)
1	G1	12	2.0 $\pm$ 0.2	37.9 $\pm$ 11.0^{b}	123.0 $\pm$ 18.7^{b}	41.7 (5/12)
2	G2	14	2.1 $\pm$ 0.3	27.3 $\pm$ 3.2^{a}	46.7 $\pm$ 2.7^{a}	85.7 (12 /14)

$^{a, b}$ - Values with different superscripts within a column vary significantly ($P < 0.01$)

It was quite interesting to observe that the conception rate was also significantly improved in the G2 group which could be attributed to the better observance on return/ non-return rate that aided in early attention to the non-pregnant animals in terms of adapting a timely therapy.

By perusing the data, it could be concluded that the OMC as a management tool could contribute to i) improve the oestrus detection attitude among the farm personnel ii) ease out the recording of breeding data iii) improve the conception rate iv) reduce the inter-calving period and v) consequently improve the profitability of the farm.

ACKNOWLEDGEMENTS

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REFERENCES

Abdullah, M., Mohanty, T.K., Kumaresan, A., Mohanty, A.K., Madkar, A.R., Baithalu, R.K. and Bhakat, M. (2014). Early pregnancy diagnosis in dairy cattle: economic importance and accuracy of ultrasonography. *Advances in Animal and Veterinary Sciences*, **2**(8): 464-467.

Baruselli, P.S., Ferreira, R.M., Colli, M.H.A., Elliff, F.M., Sá Filho, M.F., Vieira, L. and Freitas, B.G. (2017). Timed artificial insemination: current challenges and recent advances in reproductive efficiency in beef and dairy herds in Brazil. Proceedings of the 31st Annual Meeting of the Brazilian Embryo Technology Society (SBTE); Cabo de Santo Agostinho, PE, Brazil, 17 – 19, August 2017, pp 558-571.

Fricke, P.M., Carvalho, P.D., Giordanoa, J.O., Valenzab, A., Lopes Jrc, G. and Amundson, M.C. (2014). Expression and detection of estrus in dairy cows: the role of new technologies. *Animal*, **8**: 134–143.

Mayo, L.M., Silvia, W.J., Ray, D.L., Jones, B.W., Stone, A.E., Tsai, I.C., Clark, J.D., Bewley, J.M. and Heersche, G. (2019).Automated estrous detection using multiple commercial precision dairy monitoring technologies in synchronized dairy cows. *Journal of Dairy Science*, **102**: 2645-2656.

Snedecor, G.W and Cochran, W.G. (1994), Statistical methods (8thed). Iowa State University Press, USA.

Stevenson, J.S. and Call, E.P. (1983), Influence of early estrus, ovulation, and insemination on fertility in postpartum Holstein cows. *Theriogenology*, **19**: 367–375.

PREVALENCE OF *SCHISTOSOMA NASALE* IN CATTLE IN CAUVERY DELTA REGION OF TAMIL NADU

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ABSTRACT

Nasal washings and faecal samples were collected from 110 cows during the period between July 2019 and June 2020 in and around the Orathandu, Cauvery delta zone of Tamil Nadu to document the seasonal prevalence of Schistosoma nasale and Schistosoma spindale. These samples were processed and screened by using the standard parasitological techniques. Out of 110 nasal washings, 23 samples (20.9%) confirmed the Schistosoma nasale infection by the presence of eggs. No faecal samples could be detected positive for Schistosoma spindale infection during the study period

Key Words: Cattle, Cauvery Delta, Prevalence study**,** *Schistosoma nasale*, *Schistosoma spindale*, Tamil Nadu

INTRODUCTION

Nasal schistosomosis is caused by the blood fluke *Schistosoma nasale* in cattle and buffalo and the disease is commonly called as Snoring disease. It is recognized as the fifth major helminthosis of domestic animals in the Indian subcontinent (Sumanth *et al*., 2004). *Indoplanorbis exustus,* is the fresh water snail acting as intermediate host for this disease. Cauvery delta region of Tamil Nadu is considered as a rich source of fresh water in the river, irrigation channel and lakes throughout the year which attributes more snail population in this region. Yogeshpriya *et al.* (2017) reported the clinical case of nasal schistosomosis in cattle at Orathanadu, Cauvery delta zone of Tamil Nadu.

This study has been carried out to document the seasonal prevalence of *Schistosoma nasale* and *Schistosoma spindale* in cattle in and around Orathanadu, Thanjavur district of Tamil Nadu.

MATERIALS AND METHODS

Nasal washings and faecal samples were collected in normal saline solution and zip block covers respectively from 110 cows and Kannanthangudi, Oorachi, Paruthikottai and Thennamanadu of Orathanadu Taluk, Thanjavur district and Veterinary Clinical Complex, VCRI, Orathanadu were used as sampling areas for this study.

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A total of 110 nasal washings were processed by adding 5-10 ml of 10% NaOH solution in a test tube and boiled for 2-3 minutes for removal of tissues and cooled. After the centrifugation at 2000 rpm for 3 minutes, the supernatant solution was discarded and sediment was examined for the presence of *S. nasale* eggs. A total of 110 faecal samples were also processed by the sedimentation technique and screened for presence of *Schistosoma spindale* eggs.

RESULT AND DISCUSSION

Microscopic examination of nasal washings confirmed the presence of boomerang or palanquin shaped egg with terminal spine and fully developed miracidium in 23 samples (Fig.1). These eggs were identified as *S. nasale* as per the standard taxonomical keys given by Soulsby (1982). *Schistosoma nasale* eggs in nasal scrapings of cattle was also reported by Banerjee and Agrawal(1992), Sumanth *et al*. (2004) in Karnataka, Ravindran and Kumar (2012) in Kerala and Latchumikanthan *et al.* (2014) in Puducherry. No faecal samples could be detected positive for *S. spindale* eggs.

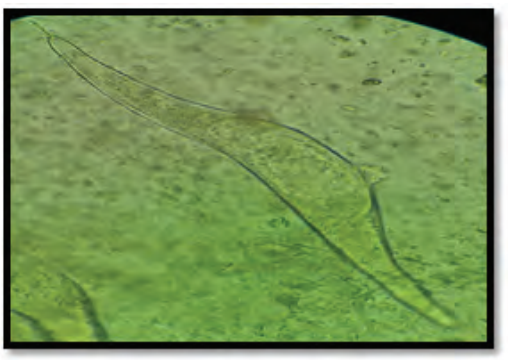

Fig.1. Boomerang shaped or palanquin shaped *Schistosoma nasale* eggs

The present study revealed that 20.9% prevalence of *S. nasale* infection in cattle in Orathanadu, Cauvery delta region of Tamil Nadu. Similarly, Muraleedharan *et al*. (1976) and De Bont *et al*. (1989) reported the prevalence rates of 10 - 15 % and 12.6 % infection for *S. nasale* in cattle in Karnataka and Sri Lanka respectively.

The major reason for the prevalence of *S. nasale* infection in the Cauvery delta region might be due to running of fresh river water round the year. The transmission of infection occurs in cattle by cutaneous penetration of cercaria of *S. nasale* from the infected *Indoplanorbis* spp. snails to the susceptible animals during the time of grazing.

In order to control the infection, grazing near water bodies infected with snails should be avoided (Soulsby, 1982). Control of snails, early diagnosis, treatment and periodical deworming in cattle help in the control of schistosomosis in ruminants.

CONCLUSION

The prevalence of *S. nasale* infection in cattle was 20.9%. No *S.spindale* could be detected in faeces of animals during the study period in the village viz., Kannanthangudi, Oorachi, Paruthikottai and Thennamanadu, Orathanadu Taluk, Thanjavur district of Tamil Nadu.

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REFERENCES

Banerjee, P.S. and Agrawal, M.C. (1992). Epizootiological studies in bovines on fluke infections with special reference to schistosomiasis. *Indian Veterinary Journal*, **69**:215–220.

DeBont, J., Van Aken D., Vercruysse, J., Fransen, J.M., Southgate, V.R. and Rollinson, D. (1989).The prevalence and pathology of *Schistosoma nasaleRao*, 1933 in cattle in Sri Lanka. *Parasitology*, **98**:197–202.

Latchumikanthan, A., Pothiappan, P., Ilayabharathi, D., Das, S.S., Kumar, D. and Ilangovan, C. (2014). Occurrence of *Schistosoma nasale* infection in bullocks of Puducherry. *Journal of Parasitic Diseases*, **38**(2):238–240.

Muraleedharan, K., Kumar, S.P. and Hegde, K.S. 1976. Studies on the epizootiology of nasal schistosomiasis of bovines, intensity and severity of infection. *Mysore Journal of Agricultural Sciences*, **10**(3):463–470.

Ravindran, R. and Kumar, A. (2012).Nasal schistosomiasis among large ruminants in Wayanad, India. *The South East Asian Journal of Tropical Medicine and Public Health*, **43**(3):586.

Soulsby, E.J.L. (1982). Helminths, Arthropods and Protozoa of Domesticated Animals, 7th Edn. Bailliere Tindall Ltd, London.

Sumanth, S., D'Souza, P.E. and Jagannath, M.S. (2004). A study of nasal and visceral schistosomiasis in cattle slaughtered at an abattoir in Bangalore, South India. *Revue scientifique et technique (International Office of Epizootics)*, **23**(3): 937-942.

Yogeshpriya, S., Saravanan, M., Jayalakshmi, K., Veeraselvam, M., Krishnakumar, S. and Selvaraj, P. (2017). Nasal schistosomiasis in cattle-A clinical case report. *International Journal of Science, Environment and Technology*, **6**(2): 1071-1074.

GROSS MORPHOMETRIC MEASUREMENTS OF UDDER IN TELLICHERRY GOATS

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ABSTRACT

The present study was conducted with the aim of establishing the basic data about gross morphometric measurements in lactating and non-lactating (n=15 each) adult Tellicherry she-goats. These goats had two mammary glands (right and left halves) divided by an inter mammary groove and each had a single teat. Udder circumference and inter teat distance differed between lactating and non-lactating animals. Udder length (UL) width of right (R-UW) and left (L-UW) quarter, right and left teat length, teat diameter at base (TDB), teat diameter at tip (TDT), Teatto floor distance (TFD) and teat end floor distance (TEFD), right and left teat diameter at base (TDB), right and left teat diameter at tip (TDT) did not differ between lactating and non-lactating Tellicherry she-goats.

Key Words: Morphometry, Tellicherry, Udder, Teat.

INTRODUCTION

The mammary gland is a modified cutaneous gland common to all female mammals. It is a milk-producing gland to nourish and protect neonate (Schmidt, 1971). Mammary gland morphology is generally accepted as a key factor for machine milkability and its inclusion in dairy goat improvement programs is widely recommended. The anatomical and morphological characteristics of the udder and its relationship with milk production, machine milkability and manageability in dairy sheep has become a greater interest from farmers to researchers (Rovai *et al.*, 2004).

Tellicherry goat is one among the recognized breeds of goats in India. It is widely distributed in Malabar region of Kerala and also reared in different places of Tamil Nadu. This breed is considered as a unique genotype exhibiting higher multiple birth percentages and higher milk yields (Sundaram *et al.*, 2012). Gross morphometric measurements in various machine milked sheep and goat breeds is reported by several authors. The present study is aimed to assess the udder morphometric traits in adult lactating and non-lactating Tellicherry she-goats that

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are reared in semi-intensive system during manual milking.

MATERIALS AND METHODS

The gross morphometric measurements of udder and teat were taken from thirty healthy Tellicherry she-goats in Post Graduate Research Institute in Animal Sciences unit of Tamil Nadu Veterinary and Animal Sciences University, Tamil Nadu. Animals were divided into two groups based on physiological status as lactating and non-lactating (n=15 each) group. The gross anatomical parameters of mammary gland such as udder length (UL) from base of the gland to the base of the teat along the inter-mammary groove, width of right(R-UW) and left (L-UW) quarter (distance between two lateral borders of the gland to the inter-mammary groove), udder thickness (UT) (the distance between cranial and caudal borders of the gland at base) and udder circumference (UC) at base were measured using measuring tape (Paramasivan, 2007).

The gross anatomical parameters of teats *via.,* (TL) teat length(distance between base and tip),teat diameter at base (TDB),teat diameter at tip(TDT), the inter-teat distance (ITD) at the base was measured using a measuring tape and vernier caliper (Paramasivan, 2007). (TDB) Teat to floor distance (distance between the base of the teat to the ground) and (TEFD) teat end floor distance (distance between the tip of the teat to the ground) for both right and left teats was recorded by using measuring tape (Venkatesan, 2014). SPSS26.0 for Windows was used for statistical analysis of data.

RESULTS AND DISCUSSION

Udder

Gross morphometric parameters such as udder thickness (UT) (cm), udder length (UL) (cm), right udder width (R-UW) (cm), left udder width (L-UW) (cm) and udder circumference (UC) (cm) in Tellicherry goats of both lactating and non-lactating animals were given in Table 1. Of these parameters, a significant difference ($P \leq 0.05$) was observed in udder thickness and udder circumference between lactating and non-lactating groups in she-goats. These findings were in agreement with the Martinez *et al.,* (2010) in Chilota and Suffolk Down sheep breeds, Abu *et al.*(2013) in West African Dwarf goats and Upadhyay *et al.* (2014) in local goats of Rohilkhand. This might be due to increased udder volume during lactation in globular shaped udder of Tellicherry she-goats.

Teat

Various gross morphometric measurements such as inter teat distance (ITD) (cm), right teat floor distance (R-TFD) (cm), left teat floor distance (L-TFD) (cm), right teat end to floor distance (R-TEFD) (cm), left teat end to floor distance (L-TEFD) (cm), right teat length (R-TL) (cm), left teat length (L-TL) (cm), right teat diameter at base (R-TDB) (cm), left teat diameter at base (L-TDB) (cm), right teat diameter at tip (R-TDT) (cm), left teat diameter at tip (L-TDT) (cm) were recorded in lactating and non-lactating Tellicherry goats (Table 1).Statistically, significant difference was recorded in inter teat distance between lactating and non-lactating she-goats. This is in accordance

with the findings of Rovai et *al.*(1999) in Manchega and Lacaune sheep breeds, who reported that the distance between teats did not show any changes in the first six week of lactation, and after that size of the teat and inter teat distance reduced after the weaning of lambs (non-lactating stage). This suggested that the productive capacity of the ewe is related to the distance between teats. No significant difference (P≥0.05) recorded in teat length (both right and left) between lactating and non-lactating animals. Between both lactating and non-lactating groups, the teat floor distance revealed no significant difference. These findings were in total agreement with Abu *et al.* (2013) in West African Dwarf goats. No significant difference was observed in teat end floor distance between lactating and non-lactating groups of ewes and she-goats. This is in agreement with the earlier findings of Venkatesan (2014) in cows. In both ewes and she-goats, no significant difference (P≥0.05) was observed in R-TDB, L-TDB, R-TDT and L-TDT between the lactating and non-lactating animals as reported by Paramasivan e*t al,* (2013) in Madras Red ewes.

Table 1. Mean ± SE of various gross morphometric measurements in udder and teat of Tellicherry she-goats.

Parameters (cm)	Mean ± SE		t-value
	Lactating (N=15)	Non-lactating (N=15)	
UT	10.50 ± 1.19	13.22 ± 0.55	2.40*
UL	12.00 ± 1.47	13.44± 0.70	1.01^{NS}
R-UW	6.25 ± 0.47	7.38 ± 5.34	1.27^{NS}
L-UW	5.37 ± 0.55	6.23 ± 0.66	1.15^{NS}
UC	26.33 ± 1.71	23.0 ± 1.69	2.42*
ITD	5.83 ± 0.86	4.25 ± 0.32	1.81*
R-TFD	35.87 ± 2.05	30.83 ± 1.64	1.77^{NS}
L-TFD	32.05 ± 2.71	31.07 ± 0.77	0.96^{NS}
R-TEFD	31.62 ± 1.71	29.22 ± 1.03	1.94^{NS}
L-TEFD	32.50 ± 1.84	29.63 ± 0.60	2.11^{NS}
R-TL	4.30 ± 0.82	4.47 ± 0.24	0.27^{NS}
L-TL	4.12 ± 0.82	4.16 ± 0.35	0.05^{NS}
R-TDB	1.01 ± 0.81	1.00 ± 0.13	0.05^{NS}
L-TDB	0.92 ± 0.09	0.96 ± 0.06	0.36^{NS}
R-TDT	0.54 ± 0.07	0.54 ± 0.05	0.07^{NS}
L-TDT	0.45 ± 0.17	0.52 ± 0.05	0.50^{NS}

NS - No significant (P>0.05)difference between lactating and non-lactating groups
* - Significant (P≤0.05) difference between lactating and non-lactating groups

It is concluded that the udder circumference and inter-teat distance differed between lactating and non-lactating Tellicherry goat; whereas, other morphometric measurements are similar between groups.

REFERENCES

Abu, A.H., Mhomga, L.I. and Akogwu, E.I. (2013). Assessment of udder characteristics of West African Dwarf (WAD) goats reared under different management systems in Makurdi, Benue State, Nigeria. *African Journal of Agricultural Research*, **8**(25):3255-3258.

Martinez, E., Calderon, C., Barra, R.D.L., Fernando de la fuente, L. and Gonzalo, C. (2010). Udder morphological traits and milk yield of Chilota and Suffolk Down sheep breeds. *Chilean Journal of Agricultural Research*, **71**(1):90-95.

Paramasivan, S. (2007). Gross anatomical and histo morphological studies on hypo thalamo- hypo physio-mammary axis of sheep (*Ovis aries*). (Ph.D thesis), Tamil Nadu Veterinary and Animal Sciences University, Chennai, India.

Paramasivan, S., Geetha Ramesh, Ushakumary, S., Basha, S.H., Kannan, T.A. and Kumaravel, A. (2013). Gross and microscopic anatomy of teat in Madras Red sheep. *Indian Veterinary Journal*, **90**(4): 44-47.

Rovai, M., Thomas, D.L., Berge, Y.M. and Caja. G. (2004). Udder morphology and effects on milk production and ease of milking in dairy sheep. Proceedings of the 10th Great Lakes Dairy Sheep Symposium, Wisconsin. Bushnell, Nebraska, pp:79-114.

Rovai, M., Such, X., Piedrafita, J., Caja G. and Pujol, M.R. (1999). Evolution of mammary morphology traits during lactation and its relationship with milk yield of Manchega and Lacaune dairy sheep. In: Milking and milk production of dairy sheep and goats. EAAP Publication, Wageningen Pers., Wageningen, pp: 107-109.

Schmidt, G.H., (1971). Biology of lactation. Freeman and company, San Francisco, pp: 82.

Sundaram, M., Muthtiramalingam, S.T., Rajkumar, I.S.I, Nishanth, B. and Sivakumar, T. (2012). *International Journal of Diary Science Research*, **1**(3): 9-11.

Upadhyay, D., Patel, B.H.M., Kerketta, S., Kaswan, S., Sahu, S., Bhushan, B. and Dutt, T. (2014). Study on udder morphology and its relationship with production parameters in local goats of Rohilkhand region of India. *Indian Journal of Veterinary Research*, **48**(6):615-619.

Venkatesan, M. (2014). Evaluation of milk flow disorders and associated mastitis status in dairy cattle. (M.V.Sc thesis), Tamil Nadu Veterinary and Animal Sciences University, Chennai, India.

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