



Developmental horizons for embryos and foetii of the buffalo

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The study on developmental horizons of different embryos and foetii in buffalo will help the veterinarians in assessing the age of embryos and foetii besides depending on formulae. Evans and Sack (1973) outlined the external features of different stages of embryos and foetii in cattle. However very limited information is available in buffalo (Singh *et al.* 1963). Hence, the present study was undertaken in view of the veterinarians to distinguish buffalo foetii from cow foetii in medicolegal cases.

The study was conducted on 52 buffalo embryos and foetii from 26 to 310 days. The prenatal embryos and foetii of unknown age were collected from different slaughter houses. The age of the specimens was calculated by

adopting Soliman (1975) formula coined for buffalo i.e $Y = 28.66 + 4.496 X$ if CVRL is < 20 cm and $Y = 73.544 + 2.256 X$ if CVRL is ≥ 20 cm, where Y is the age in days and X is the curved crown rump length in centimeters. The age of embryos of 26 and 27 days was arrived based on external features given in the following table since minimum standard value of Soliman's formula is 28.66.

Various external features of body including somite and branchial arch development, eye, ear, nose formation, development of external genitalia, limb development, pilosity, eruption of different types of milk teeth and pigmentation of the skin were studied and they were used as criteria for determining the age of the specimens

Table 1. Gross features of different embryonic and foetal stages in buffalo

Gestation age (days)	CVRL (cm)	Gross features of embryos and foetuses
26	—	The embryo was in the form of “C” shaped structure. Forelimb buds were in the form of ridges (Fig. 1). Heart and liver prominences were evident. Branchial arches were evident.
27	—	Hindlimb buds were in the form of low ridges.
38	2.1	Eye was established. Nasal pit was evident. Lateral swellings of tongue were evident. Slight deepening of branchial groove indicating future external acoustic meatus was observed. The lateral palatine processes were evident. Ist branchial arch was divided into maxillary and mandibular prominences enclosing stomodeum (Fig. 2). Somites were still evident. Limb buds were flat and constricted in the middle. Mesencephalic prominence was observed. Genital tubercle and tail were evident.
40	2.5	A sensory nodule on skin at cranial part of mandibular space was evident, which is a characteristic feature of buffalo when compared to cow. Enlargements of liver and heart were distinct. Tongue was clearly evident. Depression of external acoustic meatus was observed.
42	2.9	Somites were not evident.
43	3.2	Lateral palatine processes were horizontal. Prominent cephalic dome was evident. Pinna partly covered external acoustic meatus. Distal part of fore and hindlimb buds started showing some differentiation of digits. Early formation of eyelids was evident (Fig. 3).
46	3.8	Growing pinna was seen. Distal part of fore and hindlimbs showed four divisions (Fig. 4).
47	4.0	Neck was evident. The cephalic dome was receding. The two central divisions of distal part of limbs representing third and fourth digits were elongated while the remaining two representing 2 nd and 5 th digits were receded. Genital swelling was observed.

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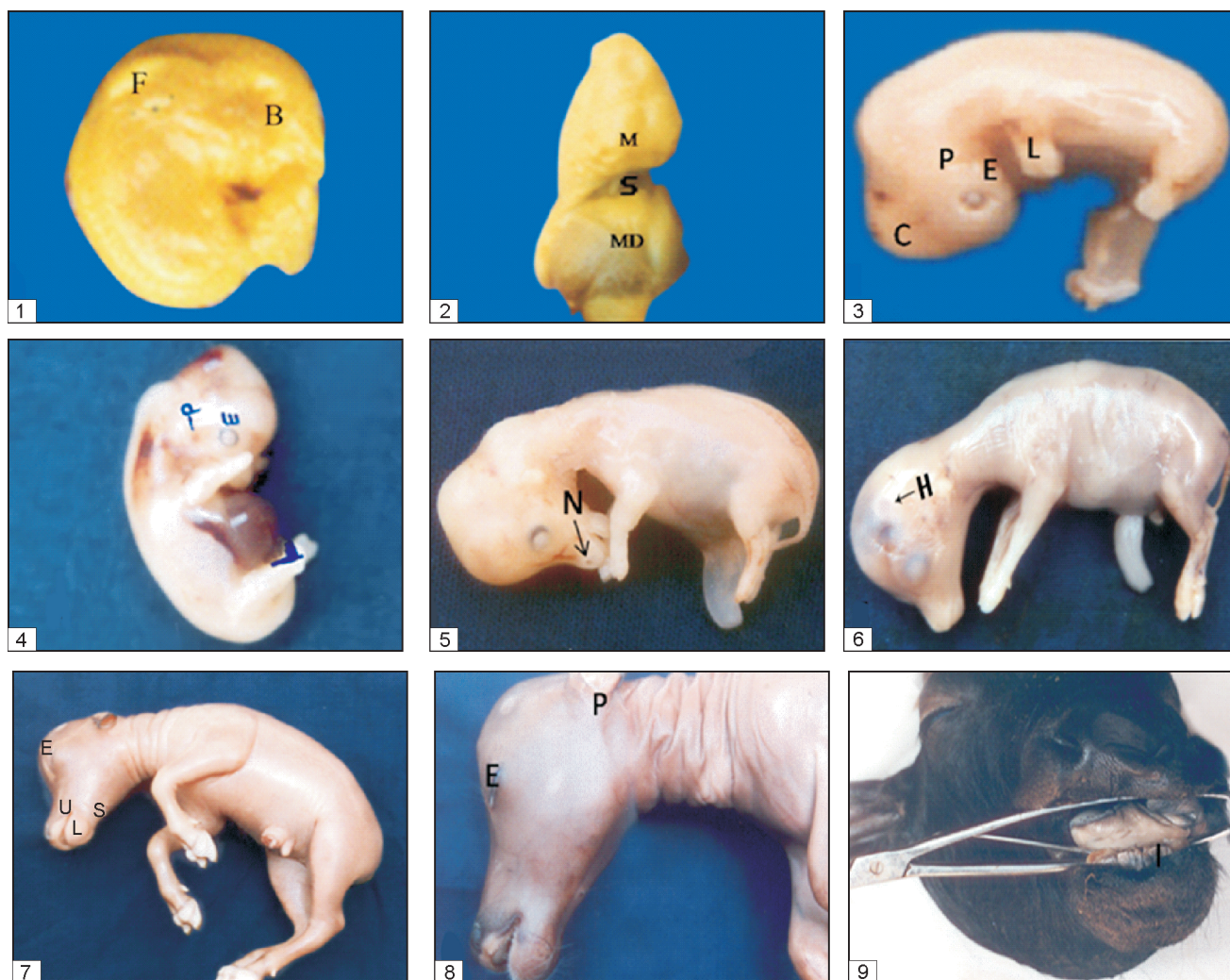
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in buffalo (Table 1).

The development of fore and hind limb buds was evident at 26 and 27 days respectively. However, they were reported to be formed at 24 and 26 days in cow (Evans and Sack

(continued table 1)

Gestation age (days)	CVRL (cm)	Gross features of embryos and fetuses
48	4.4	Pinna covered external acoustic meatus. Sex differentiation was evident.
49	4.5	Palatine processes were fused.
51	5.0	Teats were two on either side arranged in an arc form in male which were more or less squarely placed in female.
52	5.3	Different joint regions of the fore and hind limbs were clearly evident.
55	5.9	Eyelids were fused.
57	6.2	Nasal pit was distinct (Fig. 5).
59	6.8	Neck was elongated.
62	7.4	Pinna showed ridges on internal surface. Scrotum was distinct. External genitals were differentiated.
66	8.3	The curvature of foetus changed from C shape to typical adult vertebral curvature. Raised area of hoof was evident.
68	8.8	Pinna was erect.
70	9.2	Light brown pigmentation of muzzle, upper and lower lips was observed. Few hair follicles appeared on eyebrows, lower lip and corners of upper lip
72	9.6	Horn buds were represented as rounded white spots (Fig.6).
80	11.5	Hooves began to cornify.
82	11.9	Distinct scrotal raphae were evident.
86	12.8	Pinna was directed caudally exposing acoustic meatus.
88	13.1	Tips of hooves showed slight greenish yellow pigmentation.
90	13.7	Nostrils attained characteristic shape. Separation of lips and gums was clearly evident.
95	14.7	Dark brown to black pigmentation of muzzle was noticed.
99	15.6	Hooves were firm and opaque.
110	18.0	Brown pigmentation of skin on frontal and parietal regions was evident.
113	18.8	Greenish yellow pigmentation was evident on dew claws.
117	19.7	Papillae were evident on buccal mucosa.
120	20.6	Black pigmentation of free margins of eyelids was evident. Short fine hairs started appearing on lower lip, corners of upper lip, eyebrows and on the sensory nodule at mandibular space. Three bulgings covered by gum representing central, first and second intermediate incisors were evident.
133	26.2	Characteristic brown pigmentation of entire body was evident. Four bulgings covered by gum representing all four incisors were evident.
142	30.5	Fine hairs covered lower lip, corners of upper lip and eyebrows (Fig. 7).
144	31.2	Horn buds were round with slight elevation.
148	33.0	Long hairs were observed on lower lip and corners of upper lip and eyebrows.
150	34.0	Transition from brown to black appearance of skin began. Teats were arranged in almost a straight line in males. Hooves and dewclaws were hard.
155	36.0	The wall of hooves showed black pigmentation towards coronet region more so on abaxial and dorsal side and was slightly greenish yellow elsewhere. Dewclaws were slightly black at their bases and slightly greenish yellow elsewhere.
164	40.0	Eyelashes were evident. Short hairs were evident on the internal surface of base and to some extent on body of pinna (Fig. 8).
168	41.7	All incisor primordia were round.
169	42.2	Skin over frontal and parietal regions of the skull, eyelids, upper and lower lips and pinna attained black pigmentation.
170	42.6	Descent of testes into scrotum was complete.
172	44.1	Dish shaped face was attained.
184	49.0	Horn buds were surrounded radially by hairs.
193	53.0	Skin over entire head showed black pigmentation. Incisor primordia showed sharp edges.
198	55.0	Eyelids were separated. Short hair were evident on eyelids.
210	60.5	Short hair began to cover forehead region. Eye lids were densely haired.
220	65.0	Horn buds appeared as rounded projections on small cornual processes. Central incisors were $\frac{1}{4}$ up.
225	67.0	Entire head and body was hairy. The wall of hooves and dew claws were black except at tips of toes and apex of dew claws where they were greenish yellow.
261	83.0	Central incisors were more than $\frac{1}{4}$ up.
283	93.0	Central incisors were $\frac{1}{2}$ up.
299	100.0	Central incisors were $\frac{3}{4}$ up.
310	105.0	Central incisors were nearly erupted (Fig. 9).



Figs. 1–9. 1. Photograph of 26 day buffalo embryo showing development of fore limb bud (F) and branchial arches (B); 2. Photograph of 38 day buffalo embryo showing division of 1st branchial arch into maxillary (M) and mandibular prominences (MD) enclosing stomodeum (S); 3. Photograph of 43 day buffalo embryo showing prominent cephalic dome (C), pinna (P) partly covering external acoustic meatus, early formation of eyelids (E) and limb buds (L) with some differentiation of digits; 4. Photograph of 46 day buffalo embryo showing growing pinna (P) and limb buds (L) with four divisions at their distal parts. E. Eye; 5. Photograph of 57 day buffalo foetus showing distinct nasal pit (N); 6. Photograph of 72 day buffalo foetus showing horn buds in the form of round white spots (H); 7. Photograph of 142 day buffalo foetus showing fine hairs covering lower lip (L), corners of upper lip (U) and eyebrows (E). Sensory nodule in the cranial portion of mandibular space (S); 8. Photograph of 164 day buffalo foetus showing eyelashes (E) and short hairs on the internal surface of base of pinna (P); 9. Photograph of 310 day buffalo foetus showing nearly erupted central incisors (I).

1973). The development of branchial arches was clearly evident at 26 days as reported by Noden (2000) in ox. Distinct stomodeum was observed between maxillary and mandibular prominences at 38 days. However, the early formation of mouth was reported to be evident at 40 days by Singh *et al.* (1963) in buffalo. A sensory nodule with sinus hair follicles was evident on skin at the cranial part of mandibular space in specimens of 40 days onwards whereas it was reported to first appear at 45 days in buffalo by Lalitha *et al.* (1994). The horn buds were represented as rounded white spots at 72 days. However, they were reported to appear at 60 days in cow by Evans and Sack (1973). Sex differentiation was evident at 48 days while, the scrotal development in bovines was reported to be observed at 90 days by Bistner *et al.* (1973).

SUMMARY

The study was conducted on 52 buffalo embryos and foetii from 26 to 310 days. Early formation of forelimb buds and branchial arches was evident at 26 days. The cephalic dome was prominent at 43 days. A sensory nodule made up of sinus hair follicles was evident on skin at the cranial part of mandibular space in the specimens of 40 days onwards. Sex differentiation was first evident at 48 days and the differentiation of external genitalia was observed at 62 days. Descent of testes into scrotum was complete at 170 days.

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