



Documentation of Physiological Parameters and Blood Profile in Newly Born *Kajli* Lambs

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ABSTRACT : Newly born lambs have to face challenges in a new environment totally different from that of the uterus. Adaptation to extra-uterine life involves functional changes with almost each organ and system in the body undergoing a series of metabolic and anatomical modifications. Failure to adapt the extra-uterine environment can not only lead to homeostatic disturbances but also lead to the death of the affected lambs. Hematological parameters of newly born lambs show variability that differs between breeds of lambs. The purpose of present study was to determine homeostatic responses and physiological reference values in *Kajli* breed lambs occurring in the neonatal period through changes in blood profile, respiratory rate, heart rate, live weight and rectal, scrotal and skin temperatures. For this purpose, sixteen clinically fit lambs (males = 10 and females = 6) with a mean body weight 6.92 ± 0.46 kg were selected. Physiological data of selected parameters of each *Kajli* lamb was recorded at three day intervals and hematological parameters at five days for a period of 30 days. In general, statistical analysis showed a significant effect of time ($p < 0.001$) on all the studied physiological and hematological parameters except platelets counts, white blood cells and hemoglobin concentration. The results documented in the current study are an addition to existing knowledge of the physiology of *Kajli* sheep breed should be helpful in developing feeding, disease diagnoses and treatment protocols for newborn *Kajli* stock. (**Key Words :** Neonatal Period, Body Temperatures, Heart Rate, Respiratory Rate, Hematological Parameters, *Kajli* Lambs)

INTRODUCTION

Newborn lambs are usually threatened by multiple risk factors particularly to perinatal diseases, disorders of non-infectious aetiology or by pathological conditions of microbial or parasitic, which may lead to high rate of mortality due to weak or less developed immune system at this critical stage of life span (Fragkou et al., 2010). About 10% of the alive born lambs can die on the day of birth because of different factors and this indicates death of almost half of all pre-weaning lambs (Dwyer, 2008). Modification and adjustment of extra-uterine environment according to the needs of newborn in the first week of life can greatly reduce the death rate (Nowak et al., 2000; Sawalha et al., 2007). However, because of differences in breed and species the adaptation response to the new environment by lambs may differ and evidence does exist

that lambs may fail to cope with the modifications associated with independent life because of their inability to maintain homeothermy and establish breathing (Sawalha et al., 2007). In this context, initiation of regular breathing, modification in lungs and gas exchange, alteration of the circulatory pattern and regulation of temperature are considered of vital significance in order to ensure the smooth transition of newborn from uterine to neonatal life (Leone and Finer, 2006).

Cardio respiratory system undergoes prominent changes in neonatal period (Knottenbelt et al., 2004) and it can be influenced by season, day timings, ambient temperature, humidity and exercise (Fahmy, 1994; Marai et al., 2007). Fetal heart rate also shows variability from low to high around parturition and then develops typical variability depending on activity in later life (Desmond et al., 1963). Furthermore, maintenance of homeothermy during this transition period strongly supports the well being of lambs, however, failing of this may lead to increase mortality rate (Dwyer, 2008). In uterus, fetus is completely adapted to its environment having stable temperature about 0.5°C higher than the maternal temperature (Gunn and Gluckman, 1983).

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Neonatal lambs are not capable to face cold and heat stress and they show response to high temperature by change in respiratory rate and irregular breathing (Symonds et al., 1995).

Birth weight is also an important factor which plays a pivotal role in the maintenance of body temperature and growth in new life. Lambs born with light weight (4.1 kg) are known to have a reduced ability to maintain body temperature as compared to heavier (5.2 kg) lambs (Susic et al., 2005; Dwyer, 2008). An increase in ambient temperature results in rise of rectal, skin and scrotal temperatures which could be different in different seasons and day timings (Yousaf, 1985; Taylor and Bogart, 1988; Fahmy, 1994). Moreover, birth weight can be influenced by breed and sex during pregnancy (Buschmann et al., 1993). Low birth weight lambs, being less energetic and having fewer tissue reserves, take much time to reach the udder for sucking than heavier lambs (Dwyer and Morgan, 2006) which results in poor growth. In addition, body weight and growth rate can also be influenced by an elevated ambient temperature due to its effect on the metabolism, decreased anabolic and increased catabolism (Ismail et al., 1995).

Hematological parameters also pass through a series of changes and are helpful to determine the health and nutritional status of animals (Gupta et al., 2007). The implication of determining hematological parameters of domestic animals is well-documented (Obi and Anosa, 1980; Vihan and Rai, 1987). Documentation of these valuable indices in neonatal period are helpful to establish a suitable physiological baseline values for various breeds of sheep that in turn could be employed in the pragmatic evaluation of the administration practice, nourishment and diagnosis of health condition in the most critical period of life. Studies on the blood profile have been conducted mostly in Africa and some other parts of the globe and these were on adult animals. The scientific information regarding physiological and hematological parameters in newborn lambs of *Kajli* sheep breed is very limited.

Keeping in view the importance of having physiological reference values as indicators of dynamic homeostatic processes taking place during the first 30 days following the birth of a lamb, the present study, therefore, was undertaken to observe hematological parameters, body temperatures, respiratory and heart rate and live weight gain to obtain and document valuable information for neonatal care of *Kajli* lambs.

MATERIALS AND METHODS

Study area and animal characteristics

Present study was conducted on Livestock Experiment Station, Khizarabad, located in district Sargodha (32.08°N

and 72.67°E), Punjab, Pakistan. This is an agricultural area famous for citrus fruit production. Climatic conditions of this area are extreme with the temperature ranging from 5 to 49°C.

Sheep breed *Kajli* is inhabitant of this region which is a large mutton breed having average body weight 45-55 kg. Adult males of this breed are heavier (>55 kg) than females (\neq 45 kg). Annual wool yield per head is 3 kg and the fiber diameter is 37 μ m. Body of the *Kajli* sheep is well developed with long pendulous ears, long legs, roman nose and short tail. *Kajli* sheep was selected for this study because it has been proposed that the young animals of this breed perform well in their natural habitat (Sargodha district) but they do not thrive well when taken to other parts of the province having similar climatic conditions.

Physiological parameters

Sixteen clinically healthy lambs (10 males and 6 females) were used in the study which was conducted from mid April to mid May, 2008. All lambs were housed with their mother during the entire study period and fed on dam's milk. On the first day of the experiment, mean age was 5 ± 1.5 days while weight was 6.92 ± 0.46 kg. For each lamb different physiological parameters (heart and respiratory rates, rectal, skin and scrotal temperatures and live weight) were recorded at a 3-day interval at the same time (8:00 AM) from 5 days post-lambing for a 30-day period. Body weight was measured with an electronic scale (Wazan Tech. Pakistan) while heart rate was determined with the help of heart rate monitor (Kyto Electronic Corporation, China) and respiratory rate recorded visually using a stopwatch over a 5 min period. Rectal, skin and scrotal temperatures were recorded using a digital thermometer (Yancheng Diling Medical Instrument Co., Ltd., China).

Hematological parameters

The blood samples were collected at each five-day interval starting from day five of neonatal period. Jugular vein was punctured and the blood placed in vacuitainers containing anticoagulant ethylene diamine tetra-acetic acid (EDTA) for hematological study. Blood samples were carried to Al-Shifa Laboratories Faisalabad city (Punjab, Pakistan) on the same day for haemocytometry and blood chemistry using fully automatic blood CP analyzer (Nihon Kohden, Japan).

Statistical analyses

Results were presented as mean \pm SD. A one-way repeated analysis of variance (ANOVA) was used to determine statistical differences between mean values of the studied parameters in the first month postpartum. All the measurements were analyzed by generalized linear model

using statistical software Minitab 12.1 (Minitab, 2002).

RESULTS

Live weight

An increase in live weight was noted right from the start of trial (6.9 ± 0.4 kg) to the end (10.9 ± 1.3 kg) with a daily weight gain of 133 g (Figure 1A). During the last 10 days of the trial, there was a marked individual variation in live weight of the lambs as clear from standard deviation bars (Figure 1A). Mean birth weight of both sexes was almost same but males were slightly heavier (0.46 kg) than females. Difference in live weight was observed with the increase in age and it was maximum at 32 days postpartum (range 8.6 kg to 13.7 kg).

Heart rate

During the 30-day study period, heart rate of lambs decreased from mean 187.8 ± 11.1 to 144 ± 12.5 beats/min (Figure 1B). This decrease in heart rate was not consistent as it decreased sharply from 5th to 11th day postpartum followed by an irregular increase and decrease ($p < 0.001$) again at the end of the trial (Figure 1B). Differences in heart rate remained unaltered ($p > 0.05$) for the following postpartum days: 8 vs. 20, 14 vs. 26, 17 vs. 23, and 17 vs. 29. Male animals had slightly higher heart rate than females throughout the study period.

Respiratory rate

Animals showed an irregular decrease in their respiratory rate from days 5th to 17th postpartum followed by an uneven increase which was less than the initial

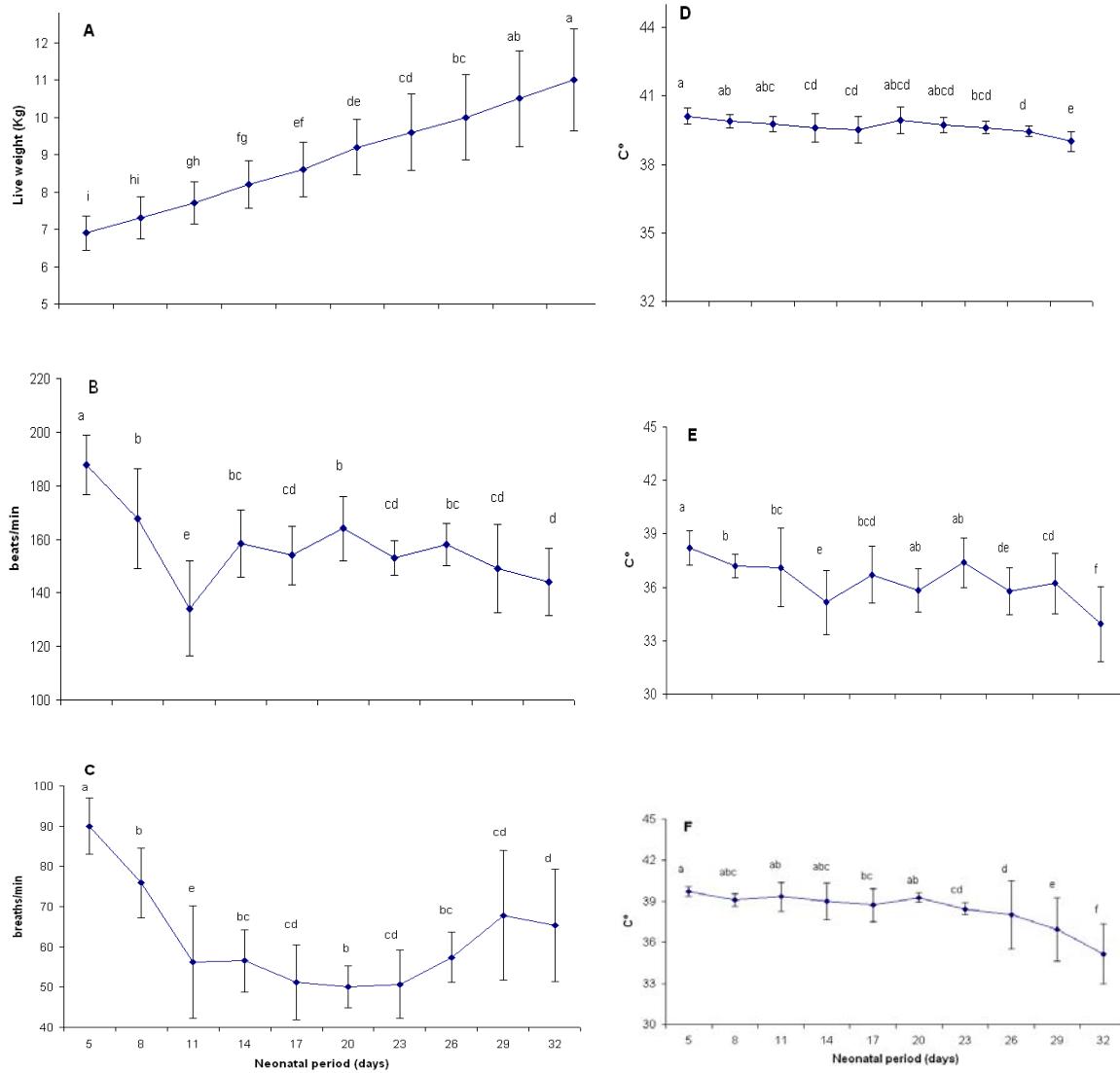


Figure 1. Mean (\pm SD) live weight (A), heart rate (B), respiratory rate (C), rectal (D), scrotal (E) and skin temperature (F) in 16 *Kajli* lambs during the first month postpartum.

observation (Figure 1C). A significant effect of time ($p<0.001$) was noted for both male and female animals while an insignificant difference ($p>0.05$) was observed among days 11 vs. 14, 17 and 26 postpartum (Figure 1C).

Temperature

Temperature recorded from three different sites showed a decrease in mean values ($p<0.001$), however, rectal temperature remains nearly constant with slight decrease at the end of trial period (Figure 1D-F). A marked decrease was observed in mean skin temperature in the last six days of the trial (Figure 1E) while that also occurred in the last three days for the scrotal skin temperature (Figure 1F). Reduction in skin temperature was gradual from the start to the end of trial except on day 20 postpartum but it was not true for scrotal skin for which uneven decrease was observed (Figure 1E, F).

Hematological parameters

Mean values of PCV, Hb, RBC, WBC, neutrophils, monocytes, lymphocytes, eosinophils and basophils are shown in Table 1. There was a significant difference ($p<0.05$) in the mean values of RBC, neutrophils, lymphocytes, eosinophils, basophils and monocytes whereas Hb, platelets and WBC level remained the same ($p<0.05$) throughout the trial period (Table 1). Basophil count decreased ($p<0.001$) from mid to the end of trial period while a considerable decrease ($p<0.001$) was also observed in the mean values of Hb, WBC, monocytes, RBC and lymphocytes ($p<0.01$). However, mean values of eosinophils increased ($p<0.001$) with the passage of time.

Mean corpuscular elements of *Kajli* lambs also showed a significant difference ($p<0.001$) during the 30 days of postpartum (Table 1). Mean values of MCV, MCH and MCHC decreased with respect to time but this reduction

was relatively more in mean MCV as compared to others.

DISCUSSION

In the present study, observations on physiological parameters of lambs were started from day 5 postpartum as rate of lamb mortality decreases beyond the first week of life (Nowak et al., 2000; Sawalha et al., 2007). An increase in live weight during neonatal period is a well established phenomenon which can be influenced by nutrition, high temperature and diseases (Shelton, 2000; Abdel-Hafez, 2002; Saddiqi et al., 2010). Linear regression model between live weight and post-natal days shows a steady increase in live weight with the increase in age of animals. Piccione et al. (2007) reported an increase of 234 g in live weight compared to 133 g observed in the present study. This discrepancy might be due to variation in genetic potential of two breeds as some breeds are known to have better growth rate than others (Marai et al., 2007), stress of summer season and management practices (Marai et al., 2008). Birth weight may be another factor that has direct or indirect effect on growth rate as vigorous lambs (5.2 kg) compared to weak lambs (4.1 kg) have better suckling potential (Susic et al., 2005; Dwyer and Morgan, 2006).

Previously, Piccione et al. (2007) reported a gradual decrease in heart rate of lambs during the first 30 days of their life whereas, in the present study, we observed an irregular decrease in heart rate during the same period. They also observed lower heart rates in contrast to the findings observed in the present study. These discrepancies might be due to difference in temperature of the two study areas as change in ambient temperature is known to influence the heart rate of young animals (Sleiman and Saab, 1995). All the observations for heart rate were taken almost at the same time of the day as it is well documented that heart beat

Table 1. Haematological parameters of *Kajli* lambs ($n = 16$) during the first month postpartum

Parameters	The day after birth						Significance		
	5	10	15	20	25	30	Male	Female	Overall
RBC $\times 10^6/\mu\text{l}$	10.60 \pm 0.83	9.34 \pm 1.61	7.20 \pm 1.33	7.37 \pm 2.34	8.72 \pm 1.84	8.97 \pm 1.99			
WBC $\times 10^3/\mu\text{l}$	13.92 \pm 4.07	13.35 \pm 5.75	9.59 \pm 7.14	9.06 \pm 4.90	11.22 \pm 5.40	11.72 \pm 5.64	**	ns	ns
Basophils (%)	0.56 \pm 0.63	0.375 \pm 0.50	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	0.00 \pm 0.00	***	**	***
Eosinophils (%)	0.68 \pm 0.70	1.19 \pm 0.83	1.12 \pm 0.96	1.37 \pm 1.36	0.87 \pm 1.26	1.87 \pm 4.75	***	**	***
Lymphocytes (%)	40.81 \pm 13.68	37.37 \pm 8.72	53.75 \pm 18.24	46.31 \pm 14.38	48.43 \pm 10.91	39.50 \pm 10.53	**	*	**
Monocytes (%)	2.12 \pm 1.54	1.56 \pm 1.03	0.25 \pm 0.58	1.00 \pm 1.21	1.00 \pm 0.82	1.06 \pm 0.77	**	**	***
Neutrophils (%)	58.18 \pm 8.07	59.31 \pm 8.53	44.06 \pm 17.71	50.06 \pm 15.51	50.25 \pm 11.21	58.18 \pm 10.25	***	ns	**
Platelets $\times 10^3/\mu\text{l}$	798.69 \pm 13.8	774.31 \pm 104	828.93 \pm 237	710.18 \pm 183	792.93 \pm 110	744.87 \pm 148	ns	ns	ns
PCV (%)	33.93 \pm 2.94	31.14 \pm 2.69	28.00 \pm 3.04	27.46 \pm 3.49	29.97 \pm 3.71	24.30 \pm 9.00	***	**	***
Haemoglobin(g/dl)	11.67 \pm 1.03	11.05 \pm 1.10	8.66 \pm 1.00	9.25 \pm 1.22	10.23 \pm 1.33	10.01 \pm 1.55	***	**	ns
MCH (pg)	12.48 \pm 1.15	11.19 \pm 0.55	11.77 \pm 0.94	11.15 \pm 0.57	10.96 \pm 0.51	10.99 \pm 0.80	***	***	***
MCHC (g/dL)	34.96 \pm 1.49	32.26 \pm 1.93	30.44 \pm 1.28	32.55 \pm 1.73	31.56 \pm 2.22	32.21 \pm 2.47	***	***	***
MCV (fL)	44.92 \pm 7.04	46.19 \pm 6.65	40.11 \pm 4.89	35.33 \pm 4.75	35.84 \pm 7.15	34.49 \pm 7.60	*	***	***

* p<0.05, ** p<0.01, *** p<0.001, ns = Non significant ($p>0.05$).

varies following walking, exercising and suckling processes (Leone and Finer, 2006). Similarly, pulse rate is also affected by morning and noon timings due to various ambient temperature peaks (Marai et al., 2007).

We observed a higher respiratory rate in *Kajli* lambs than reported by Anderson (1975). In the present study, the variations recorded for respiratory rate are consistent with previous studies indicating that this parameter displays homeostatic physiological variability during the first four weeks postpartum (Davey et al., 1998). Our observations are in concordance with those of Davey et al. (1998), whereas contrary to Piccione et al. (2007), where we noted a higher respiratory rate in male group both at the start and the end of trial but it was not true for females which showed elevated values only in middle (14 to 20 days postpartum) of the trial.

With respect to temperature, our findings are in contrast with those of Bianca and Kunz (1978) showing a better adjustment of *Kajli* in relatively high temperature. Skin temperature decreased gradually in contrast to scrotal temperature (Figure 1E, F). Previously, Fahmy (1994) and Marai et al. (2009) reported an increase in rectal and skin temperatures with the increase in ambient temperature. Various factors are responsible for irregular pattern of scrotal skin temperature which includes humidity and fluctuation in temperature during cloudy days. Sheep has efficient thermal homeostasis mostly in first month of postpartum (Piccione et al., 2002) that may be due to low quality fibrous feedstuffs into protein and other products (Hafez, 1987). Homeostasis is achieved by evaporation of water by respiratory tract by panting or sweating involving skin surface (Marai et al., 2007) and at high temperature via ears and legs. Rectal temperature increases only when physiological mechanisms of body are non-productive to counteract the unnecessary heat load. Thermoregulatory process is also influenced by birth weight and some reports suggest that lighter lambs at birth have reduced capability to sustain body temperature (Alexander, 1975; Dwyer, 2008).

A significant decrease in mean cellular counts was observed except eosinophils. Previously, Mbassa and Poulsen (1991) and Azab and Abdel-Maksoud (1999) also reported an increase in eosinophil count during the early neonatal period. In current trial, mean values of RBC decreased significantly ($p<0.001$) in first month postpartum in both male and female flocks and similar findings were documented by Azab and Abdel-Maksoud (1999). White blood cells of female *Kajli* lambs showed a slight increase ($p>0.05$) during the study period while opposite was the case in male animals. Mean values of WBC counts at the end of trial are close to reference haematological values of Girgentana goats (Opara et al., 2010). A significant increase was noted in mean eosinophil counts that may be due to

allergic response to ecto- or endoparasites (Buddle et al., 1992). In contrast to the findings of present study, Azab and Abdel-Maksoud (1999) observed significant reduction in mean eosinophil count. Mean lymphocytes values showed significant decrease in female group compared with male. Values of present experiment did not match with those of Daramola et al. (2005) where male West African Dwarf goats had higher lymphocyte count compared to the females. Reference values set for West African Dwarf goats (Opara et al., 2010) were higher (64.8 ± 1.7) than *Kajli* lamb during the same period. Neutrophil counts remained almost constant with a small decrease in middle of the trial while mean monocyte counts showed a significant decrease ($p<0.05$) which was slightly more in male group. Production of neutrophils is independent according to body's demand and health of animals. Breed, temperature and environmental factors also influence their production (Waziri et al., 2010). Animal sex is also believed to have a significant effect on neutrophil count (Daramola et al., 2005). In present study, female had increased neutrophil values in first 15 days postpartum. Similar findings have been reported earlier by Tambuwal et al. (2002) and Daramola et al. (2005). Monocytes values at day 5 postpartum resembled to the reference values of goat (Opara et al., 2010) while neutrophils cellular counts of current study were about twice than noted by Opara et al. (2010). Basophil and platelet counts showed a considerable reduction ($p<0.001$) from the start of study to the end of trial which is in contrast with the previous findings of Waziri et al. (2010).

Values of Hb are adjusted according to oxygen carrying capacity of the blood and hence its level can vary according to different age groups (Tambuwal et al., 2002). In the present study, a slight decrease in Hb concentration was observed but overall difference with respect to time was not significant ($p<0.05$) but significant ($p<0.001$) when data was analyzed sex-wise. Azab and Abdel-Maksoud (1999) also reported significant difference in Hb level during the early neonatal period. However, Iriadam (2007) found no significant change in Hb concentration in Kilis does.

Reduction in PCV values in the present study is in concordance to the previous studies (Vihan and Rai, 1987; Jain, 1993; Azab and Abdel-Maksoud, 1999; Iriadam, 2007). Mean PCV percentage was low in male animals which is in contrast to the findings obtained from Red Sokoto Nigerian goats (Tambuwal et al., 2002) in which male animals have higher PCV values than females. Mean values of corpuscular values (MCV, MCH, MCHC) have their own significance in diagnosis of diseases and to determine health status of flock. A significant decrease ($p<0.001$) in all the studied corpuscular elements was observed which is in contrast to the findings of Waziri et al. (2010). Mean values

of corpuscular elements can vary in different physiological stages, age groups and breeds (Durotoye, 1987; Mbassa and Poulsen, 1991; Waziri et al., 2010).

A significant decrease in mean values of different performed physiological and haematological parameters was noted in *Kajli* lambs during the early neonatal period. *Kajli* sheep has been morphologically and physiologically equipped to cope with extra-uterine environment and relatively higher summer temperature effectively. Documentation of first reference assessment to be published for the *Kajli* lambs would definitely be helpful for the farm management and practitioners in the diagnosis, treatments and management of diseases during the early phase of life.

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