



Characteristics of Qualitative Traits Color Patterns for Pure Bali Cattle and Brahman-Bali Cross

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ABSTRACT

The study was to examine the pattern of color distribution in pure cattle and cows from crosses between Brahman males and Bali breeds as a marker that can be an important criterion in livestock selection programs. This study used 50 pure Bali cattle and 50 crossbreed cows (Brahman-Bali Cross). The parameters observed were the cow's color pattern on the morphology of the head (face, eye iris, edge of the upper lip, muzzle, ear rims, inner ear, and horn), color pattern of body (backline, middle, lower abdomen, butt and tail end), and color pattern of leg and tight (nail, inner tight and leg). Data were analyzed descriptively, frequency, and displayed in percentage form. The characteristic color pattern of pure Bali cattle of 40% brick red face, 26% pale brown and 34% are black, the crossbreeding white 48%, brick red 22% and brownish red 30%. Pure Bali cattle have 100% black color on the iris, ear edge, muzzle, ear edge, and horns, the crossbreeding 74% black irises and 26% reddish irises. The foot morphology of the hoofs of pure cattle and crossbreeds was 100% black, while the inner thighs of both types were 100% white. The legs of pure cattle are brownish white 46% and white 54%, while the crossbreeds have 68% white and 32% reddish white. Body, head, and leg color patterns show clear genetic variation between purebred Bali cattle and their crossbred counterparts. These differences in color percentage can serve as practical visual markers for livestock selection and management.

INTRODUCTION

Bali cattle are domesticated cattle from Banteng which are native cattle from Indonesia. Bali cattle have a high adaptability to extreme regional conditions (Zulkharnaim *et al.* 2010; Aritonang *et al.*, 2017) with high carcass component value (Fatonah *et al.*, 2023) and low fat percentage (Fausiah & Al Buqhuri, 2019). However, currently Bali cattle are experiencing a decline in genetic quality marked by the lower body weight of these Bali cattle. The cause of the decline in the genetic quality of Bali cattle is due to genetic degeneration, which occurs due to genetic selection and inbreeding in villages that apply a closed mating pattern (Depison, 2010).

Artificial Insemination Centers at the central and provincial levels have developed frozen semen from superior males to be distributed throughout Indonesia. The central government with various programs that have been carried out to distribute superior semen seeds to be crossed with local cattle in Indonesia. Crossing program aims to obtain superior traits (heterosis) which are inherited from their parents and to eliminate bad traits (recessive). The Kolaka district government has included superior types of cow semen through the Upsus Siwab program of the Ministry of Agriculture. Semen from the superior male was inseminated into Bali cattle developed by farmers in Kolaka. One type of superior male semen that is indeminated into Bali cattle is Brahman bull semen. The artificial insemination program is expected to be able to improve the genetic quality of Bali cattle in Kolaka. The crossbreeding of Brahman and Bali cattle had better body weight and body size than pure Bali cattle (Depison, 2010).

On the other hand, the emergence of new color variations from the color combination of pure Bali cattle and Brahman cattle as a result of the crossing of the two breeds has resulted in the color diversity of the crossbred cattle in Kolaka Regency, Southeast Sulawesi. The

diversity of colors is high and the population of cattle resulting from artificial insemination is increasingly widespread, making it difficult to identify the type of cattle. Knowledge about the inheritance of color patterns in crosses between breeds is very necessary to facilitate the identification of purebred from impure. Color identification in cross-bred livestock is one of the initial stages in forming a new breed that is different from its parents. Fur color is a qualitative trait in beef cattle that has been used in the identification and classification of certain breeds of cattle in the livestock population, as well as a marker that can make it easier to control livestock conditions (Dauda *et al.*, 2018). Bali cattle are sexually dimorphic species, adult bulls are dark black in color and young are reddish brown. Both males and females have white patches on the buttocks and legs with dark lines along the spine in females and young cattle (Martojo, 2012). Meanwhile, Brahman cattle which are suitable for breeding in Indonesia based on SNI 7651.1:2011 are thin hairy, white in color and dark gray on the neck and shoulders (BSN, 2011). The emergence of color diversity of crossbreed is very interesting to study (Fadil *et al.*, 2018). Based on this, the authors conducted a study to examine the pattern of color distribution in pure cattle and cattle resulting from crosses of Brahman males with Bali breeds. The aim of this research is to provide guidance on the pattern of inheritance of color traits in cattle resulting from a cross between Brahman and Bali cattle and to knowledge about the inheritance of coat color will help plan the expected color patterns in cross-bred calves.

MATERIALS AND METHODS

This study used 50 pure Bali cattle and 50 and Brahman-Bali cross. This research was conducted in Kab. Kolaka, Southeast Sulawesi (Baula, Iwoimendaa, Polinggona, Tanggetada, and Wundulako).

The parameters observed in this study were the qualitative nature of cow hair color on head morphology (face, iris, upper lip, muzzle, ear edge, inner ear, and horns), (backline, body, lower abdomen, buttocks, and tip of the tail), and feet and thighs (nails, inner thighs, and feet).

Sampling was carried out by purposive sampling. The data obtained were analyzed descriptively by calculating sample proportions, frequency, descriptive analysis, and displayed in the form of a percentage for each trait. Percentage for each trait:

$$\frac{\text{Number of colors}}{\text{Total number of colors}} \times 100$$

RESULTS AND DISCUSSION

Cow's Head Morphological Color Pattern

The characteristic color pattern of pure Bali cattle on the head consists of 40% brick

red face, 26% pale brown and 34% adult male observations are black. Meanwhile, the crossbreeding of a Brahman male with a Bali breed consists of three color variations, namely; white 48%, brick red 22% and brownish red 30%. The appearance of the white gene in the offspring from the cross was caused by the gene of the Brahman cow, while the brick red and brown colors were influenced by the Bali cattle. The diversity of qualitative traits in livestock is caused by the influence of genes from their parents. This is in accordance with Saputra *et al.* (2022) that the qualitative nature of livestock is more influenced by genes than the environment.

Pure Bali cattle have 100% black color on the iris, ear edge, muzzle, ear edge, and horns. Cows from crosses of Brahman males with Bali breeds with 74% black irises and 26% reddish irises. The muzzle of the crossbreeding Brahman X Bali cattle has a

Table 1. Characteristics of color qualitative characteristics of Bali cattle and cows from crossing Brahman males with Bali females breeders in the head morphology section

Morphology	Bali cattle			Brahman x Bali cattle		
	Phenotype	Total	Percentage	Phenotype	Total	Percentage
Face	Black (male)	17	34	White	24	48
	Brick red	20	40	Brick red	11	22
	Pale brown	13	26	Brownish red	15	30
Eye iris	Black	50	100	Reddish	13	26
				Black	37	74
Edge of the upper lip	White	50	100	White	43	86
				Pale white	7	14
Muzzle	Black	50	100	Black	33	66
				Light red	11	22
				Striped (red, white, black)	6	12
Ear rims	Black	50	100	White	50	100
Inner ear	White	50	100	White	13	26
				reddish		
				White	47	94
Horn	Black	50	100	Pale black	50	100



Figure 1. Characteristics of qualitative color characteristics of cows from crossing Brahman males with Bali breeders in the head morphology section



Figure 2. Characteristics of the color qualitative characteristics of pure Bali Cattle in the head morphology section

black pattern of 66%, pink 22%, and stripes (red, white, black) 12%. The edges of the ears of the crossbreeding Brahman X Bali are 100% white, this indicates that the white color of the ears of the crossbred cattle is obtained from the male (Brahman cattle). The color of the horns of the crossbreed Brahman X Bali has a 100% pale black color pattern obtained from the combination of its parents. This is in accordance with the opinion of Bilyaro *et al.* (2024) that crosses produce a combination of traits from the parents.

The color pattern of the head on the inside of the ear and the edge of the upper lip in 100% pure Bali cattle is dominated by white. Cows from crosses Brahman X Bali, the color of the inside of the ear consists of 94% white and 26% reddish white. The upper lip of

the crossbreeding Brahman X Bali cattle was 86% white and 14% pale white. This is in accordance with the opinion of Risnawati *et al.* (2022) that pure Bali cattle have a white color on the inside of the ear and the edge of the upper lip.

Color Pattern Morphology of Cow Body Parts

The morphological color pattern of body parts in cattle consists of four parts, namely; back line, body, lower abdomen, buttocks, and tail end. The back line color pattern of pure Bali cattle is 100% black, while the Brahman cattle crossed with Bali cattle produce 64% black and 36% white stripes. The black and white colors on the back line of the crossed cattle are a combination of the nature of the

Table 2. Characteristics of the color qualitative characteristics of Bali cattle and cows from crossing Brahman males with Bali females breeders on body morphology section

Morphology	Bali cattle			Brahman x Bali cattle		
	Phenotype	Total	Percentage	Phenotype	Total	Percentage
Backline	Black	50	100	White	18	36
				Black	32	64
Middle	Brick red	21	63.64	Grey	4	8
	Dark brown (male)	7	41.18	Brownish white	29	58
	Brownish red	3	9.09	Pale brown	10	20
	Pale brown	2	6.06	Light brown	7	14
	Black (male)	10	58.82			
	Light brown	3	9.09			
	Yellowish-brown	4	12.12			
Lower abdomen	White	50	100	Pale white	50	100
Butt	White	50	100	White	36	72
				Reddish white	14	28
Tail end	Black	50	100	Black	50	100

color pattern of Bali cattle and Brahman cattle. This is in accordance with the opinion of Sairoji *et al.* (2026) that the characteristic feature of Bali cattle is the black stripe on the back.

The color pattern on the body of pure Bali cattle differs between the color of adult bulls and females. Male Bali cattle have a dark brown color variation of 41.18% and black 58.82%. The black color in bulls is in accordance with the research of Fikar & Ruhyadi (2010) that the bulls after adulthood turn black. The hair color of bulls changes to black when they mature due to the reaction of the hormone testosterone in Bali cattle. The body color pattern of the female Bali cattle is; brick red 63.64%, brownish red and light brown 9.09%, pale brown 6.06% and yellowish brown 12.12%. This result is close to the results obtained by Rajab (2021) that the percentage of Bali cattle with shiny brick red

fur is 64%, while the percentage of faded brick red is 36%. The crossbreeding of Brahma males with Balinese breeds has a pattern of gray 8%, brownish white 58%, light brown 14%, and pale brown 20%. Bali cattle are characterized by light/dark brown fur at calf stage, while adult females have red/white fur and their horns are set slightly inward from the head. Bulls, on the other hand, have black fur and their horns are set slightly outward from the head (Hermawansyah *et al.*, 2023). Color variations that occur in cows from crosses between Brahman and Bali indicate the influence of a combination of genes between the two parents.

The color diversity of pure Bali cattle in Kolaka Regency is similar to that in other regions in Indonesia, as reported by Erni *et al.* (2025) the dominant color of brick red and light brown cattle, Yurnalis & Sarbaini (2014) that the dominant color of Bali cattle is brick



Figure 3. The pattern of color distribution of body parts of cows resulting from crossing a Brahman male with a Bali breeder



Figure 4. Color distribution pattern of pure Bali cattle body parts

red, and Utomo *et al.* (2012) that the color of Bali cattle is light brown. This study is also in accordance with the opinion of Janusandi (2013) and Rajab (2021) that the hair color of Bali cattle is brick red. The color pattern on the body of the cross between Brahman males and Bali breeds varied and was dominated by brownish white 58%, pale brown 20%, light brown 14%, and gray 8%. The appearance of brown color in crossbred cattle was inherited from the Bali cattle, while the white and gray colors were inherited from the Brahman bulls.

The cause of color variation in cattle is determined by the presence or absence of melanin which consists of two parts, namely eumelanin which plays a role in determining brown or black color and pheomelanin plays a role in determining red, yellow, and red brown color patterns (Olson, 1999). Melanocortin Receptor 1 (MC1R/melanocyte stimulating hormone receptor) gene is the most important regulator of color pattern inheritance. The presence of allele variations in the cow family causes differences in coat

color (Klungland *et al.* 2008). According to Kantanen *et al.* (2000) the genes involved in influencing coat color in cattle are at least seven loci. according to Utomo *et al.* (2012) in cattle the dominant reddish brown color is regulated by a recessive gene.

The underbelly of purebred cows is 100% white while in crossbreed cows it is 100% pale white. This is in accordance with the opinion of Mubarak & Akhsan (2023) that Bali cattle have a white color on the lower abdomen. The buttocks of pure Bali cattle have a white color of 100%, while the cross between a Brahman male and a Balinese breed has a white pattern of 72% and a reddish-white color of 28%. The white pattern on the buttocks of Bali cattle is the hallmark of Bali

cattle. This is in accordance with Rahman *et al.* (2026) research that there is a white color in Bali cattle on the back of the thigh (butt). The shape of the white pattern is in the form of a white circle like a disc. The white pattern also appears in the offspring, but a reddish-white pattern also appears.

Color Pattern Morphology of the Legs and Thighs of Cows

The foot morphology of the hoofs of pure cattle and crossbreeds of Brahman X Bali cattle was 100% black, while the inner thighs of both types were 100% white. This study is in accordance with the opinion of Effendi *et al.* (2021) that the inner thigh of Balinese cowhide is white in the shape of an oval.

Table 3. Characteristics of the color qualitative characteristics of Bali cattle and cows from crossing Brahman males with Bali females breeders in the morphology section of feet and thighs

Morphology	Bali cattle			Brahman x Bali cattle		
	Phenotype	Total	Percentage	Phenotype	Total	Percentage
Nail	Black	50	100	Black	50	100
Inner thigh	White	50	100	White	50	100
Leg	Brownish white	23	46	White	34	68
	White	27	54	Red white	16	32



Figure 5. Pattern of color distribution of the legs and thighs of cows from crossing a Brahman Male with a Bali parent.



Figure 6. Color distribution pattern of the legs and thighs of pure Bali cattle.

The legs of pure cattle are brownish white 46% and white 54%, while the crossbreeds of Brahman X Bali have 68% white and 32% reddish white. The white color on the legs of the Balinese cow is the hallmark of the cow. This opinion is in accordance with the opinion of Misrianti *et al.* (2018) that the legs of Balinese cattle are white. The results of observations of the color of Bali cattle are in accordance with previous studies that white color in Bali cattle is found on the back of the thigh, the edge of the upper lip, and on the legs starting from the tarsus and carpus to the upper edge of the nail, the hair on the inside of the ear (Alamsyah, 2015). The appearance of a reddish-white color on the legs of the crossbreed cow is derived from the Brahman cow.

CONCLUSION

The head color pattern of the Brahman X Bali cross is white, brick red, and brownish red. Crossbred cows have red and black irises, pink and striped muzzles and pale black horns. The color of the back line of the cross cow produces variations in black and white. The crossbred cows have a pattern of gray, brownish white, light brown, and pale brown. The underbelly of the crossbreed cow is pale white. The legs on the hooves of cows are the result of black crosses, while the color of the inner thighs is white. The legs of a crossbreed cow are white and reddish-white. Implications for livestock identification and breeding selection. Body, head, and leg color patterns show clear genetic variation between purebred Bali cattle and their crossbred counterparts. These differences in color percentage can serve as practical visual markers for livestock selection and management.

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