Evaluation of Phenotypic Characteristics in Male Peranakan Ongole (PO) Cattle: A Case Study in the Villages Breeding Center (VBC) of Napis Village

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ARTICLE INFO	ABSTRACT
	This research evaluates the phenotypic characteristics of male Peranakan Ongole (PO) cattle in Napis Village, Tambakrejo District, Bojonegoro Regency, East Java. The research method used is a case study through observation, photography, and direct measurement. The location and research sample were determined through purposive sampling based on the characteristics of cattle according to SNI 2020 PO cattle. The evaluation encompassed 109 male PO cattle, categorized by age, ranging from PI0 to PI8. The research results show that the qualitative characteristics of male PO cattle, including dominant white body color, black eyelashes, black muzzle, horns, dewlap, and hump, are in accordance with the SNI 7651.5:2020 standard. In addition, morphometric characteristics such as body weight, withers height, body length, chest circumference, hip height, hip width, and chest depth significantly increased ($P<0.05$) with the age of the cattle. This data shows the optimal growth pattern of male PO cattle, which can be used as a reference in genetic selection programs and the development of superior-quality. This research emphasizes the strategic potential of Napis Village as a source of high-quality PO cattle in Indonesia.

1. Introduction

The Peranakan Ongole Cattle (PO) is one of the local Indonesian cattle breeds that plays an important role in the livestock sector, especially as a source of beef cattle breeding stock. The

characteristics of PO cattle are the result of crossbreeding between Ongole cattle from India and local Indonesian cattle, which were developed in Indonesia around 1930 AD [10, 25], providing advantages in adapting to tropical environments and having good reproductive capabilities. Therefore, PO cattle have become the primary choice for farmers in Indonesia to increase their livestock productivity. The Ministry of Agriculture has designated the PO cattle breed as a conservation breed in decree No. 2841/Kpts/LB.430/8/2012. According to Minister of Agriculture Decree No. 2841/Kpts/LB.430/8/2012 and 7651.5:2020, PO cattle are a source of local genetic wealth with their original distribution in Central and East Java. In Indonesia, they cover the entire region, where their breeding has been passed down through generations since 1904

Genetic selection to improve livestock quality relies heavily on phenotypes of cattle, which include physical characteristics such as body size (morphometrics), coat color, and skeletal structure. This phenotype also reflects the influence of the environment and livestock management practices, which play an important role in determining the quality of the cattle. The quantitative statistical method known as morphometrics is used to study the body dimensions of livestock, such as growth patterns, anatomy, performance, and production. Additionally, morphometrics studies the size, shape changes, and variations of organisms quantitatively, including measuring length and examining their structure. Body morphometrics can measure growth because size is an important indicator of growth [36] Measuring the body parameters of cattle helps identify the origins and phylogenetic relationships between various species, breeds, and types of cattle. Using morphological markers to identify genetic traits requires thorough examination, but these markers are not accurate due to environmental influences [11]. Genetic variables, origin location, husbandry systems, and breeding systems applied in the region can cause differences in livestock body size. [13] In addition, the research by Mahmudi et al. found that the body size of cattle includes withers height, hip height, hip width, body length, chest depth, chest circumference, chest width, and the length of the vertebral column (thoracic vertebrae, cervical vertebrae, lumbar vertebrae), radius ulna, metacarpals, tibia-fibula, and metatarsals. The study of the phenotypic characteristics of male PO cattle is becoming very important, especially in breeding source areas like Napis Village, which has the potential to become a center for providing high-quality livestock.

Napis Village, located in Tambakrejo District, Bojonegoro Regency, East Java, is one of the strategic areas for the development of Peranakan Ongole (PO) cattle breeding sources in Indonesia. This village is known for its superior PO cattle population, thanks to a combination of supportive environmental conditions, excellent farming management practices, and effective maintenance. Ministerial Regulation No. 356/KTPS/PK.040/6/2015 recognizes Napis Village as a primary area for the development of PO cattle breeding. Susilawati et al. [31] reported that almost every household raises one to three cattle in Napis Village, which is an excellent breeding source area. Female cattle dominate the cattle population in this village, and the surrounding forest-covered area offers an additional advantage by providing ample land for livestock feed planting. Based on data from the Livestock Service of Bojonegoro Regency in 2022, the cattle population in Bojonegoro Regency reached 258,563 heads, with 25,125 heads located in Tambakrejo District. The development of regions as sources of PO cattle breeding has great potential to improve the productivity and quality of the resulting PO cattle. The internal strengths of high fertility levels, the use of low-nutrient feed, and good adaptability to tropical habitats can be leveraged to maximize external opportunities such as government support and funding schemes [2]. Desa Napis, as part of this district, contributes significantly to that figure. With the population advantages and supportive environmental conditions, Napis Village has become a strategic area for researching the phenotypic characteristics of male PO cattle.

This study is anticipated to substantially advance the growth of PO cattle in Indonesia. Comprehending the phenotypic traits of PO cattle, particularly in breeding regions such as Napis Village, enables the formulation of more efficient selection and genetic enhancement tactics. Moreover, the findings of this evaluation may facilitate the sustained advancement of the national livestock sector, addressing both beef demand and the enhancement of livestock breeding quality.

2. Method

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This research was conducted in the Peranakan Ongole Cattle (PO) breeding area located in Napis Village, Tambakrejo District, Bojonegoro Regency, East Java. Data collection was conducted from January to February 2023. This research employs a case study approach, utilizing observation and direct measurement techniques. The research location was purposefully selected based on data from the Bojonegoro District Livestock Office in 2022, which shows that Tambakrejo Subdistrict is one of the main areas for PO cattle breeding in Bojonegoro District, with the largest population of 25,125 head and an active special PO cattle farming group. The determination of the research location and sample was carried out using purposive sampling techniques, with cattle characteristics criteria based on the 2015 SNI [4].

The material used in the research was 109 male PO cattle, categorized by age (PI) of the PO cattle, namely PI0 (aged <1 year), PI2 (1 – 1.5 years), PI4 (1.5 - 2 years), PI6 (2 – 3 years), PI8 (aged > 3.5 years). The results of the age determination of the cattle were used as the basis for livestock grouping. The research sample is presented in Table 1.

Table 1. Pen Grouping of Male PO Cattle Based on Age

| Location	Sample	Age of Male Peranakan Ongole Cattle				
		PI0	PI2	PI4	PI6	PI8
Napis Village	109	40	36	12	9	13

Keterangan: PI0 (aged <1 year), PI2 (1 – 1.5 years), PI4 (1.5 - 2 years), PI6 (2 – 3 years), PI8 (aged > 3.5 years)

The tools used in this research consist of a 1500 kg capacity cattle scale, a measuring rod with 1 mm precision, a measuring tape with 1 mm precision, a caliper with 1 mm precision, a computer, and applications for data analysis, including Excel and R version 4.4. 1. Interpretation of body measurements is done descriptively using mean and standard deviation values [29]. The one-way MANOVA statistical test is applied to examine the differences in mean values of variables among groups of cattle based on age differences. If MANOVA shows significant results, the analysis is continued with post hoc tests and population clustering of cattle using principal component analysis [9] The measurement of morphometric variables is presented in Figure 1, according to the method adapted from International Committee Veterinary Gross Anatomical Nomenclature [14] and [4, 5].

Table 2. Morphometric of Male PO Cattle

No.	Morphometric	Symbol	Description
1.	Withers height	GH	Measured exactly behind the scapula from the dorsal point to the floor surface.
2.	Body length	BL	Measured from the tuber humerus to the tuber ischium
3.	Chest girth	CG	Measured around the chest with a measuring tape behind the front legs
4.	Chest depth	CD	Measured just behind the scapula from the dorsal to the ventral point
5.	Hip height	HH	Measured straight from the os coxae (tuber coxae) to the floor surface
6.	Hip width	HW	Measured from the left tuber ischium to the right tuber ischium
7.	Body weight	BW	Measured using a cattle scale with a maximum capacity of 1,500 kg.

Sources: [15,17,]
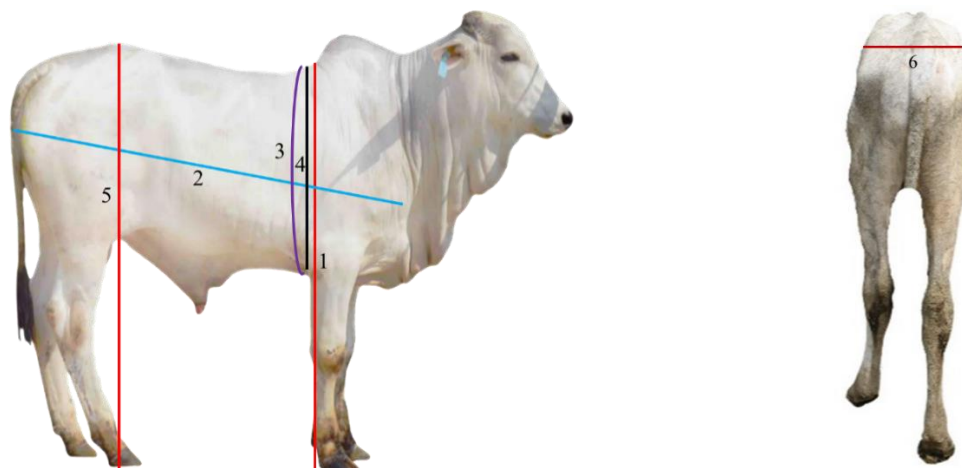
(a)   (b)

Figure 1. Measured Morphometric of Male PO Cattle

3. Results and Discussion

Qualitative Characteristics of Male PO cattle

Observation of PO cattle was conducted based on qualitative traits in 109 male cattle. The results of the qualitative data analysis of PO cattle based on body color characteristics are presented in Table 3.

Table 3. Qualitative Characteristics of Male PO cattle

Qualitative Characteristics	Total Numbers (head)	Percentage (%)	Qualitative Characteristics	Total Numbers (head)	Percentage (%)
Dominant Color			Eyelash Color		
✓ White	75	**68,81**	✓ Black	109	**100,00**
✓ Grey	34	31,19	✓ White		
✓ Other			✓ Mixed		
Snout Color			Tail Hair Color		
✓ Black	92	**84,40**	✓ Black	109	**100,00**
✓ Mixed	17	15,60	✓ Mixed		
✓ Other			✓ Other		
Upper Lip Color			Horn		
✓ Black	53	**48,60**	✓ Present	66	**60,60**
✓ Mixed	42	38,50	✓ Absent	43	39,40
✓ Other	14	12,80	Dewlap		
Lower Lip Color			✓ Present	109	**100,0**
✓ Black	32	29,40	✓ Absent		
✓ Mixed	47	**43,10**	Hump		
✓ Other	30	27,50	✓ Present	101	**92,70**
			✓ Absent	8	7,30

The research showed that the dominant body color of PO male cattle is white, with 75 individuals (70.81%), while 34 have gray body colors (31.19%). The presence of the gray color in male PO cattle is suspected to be the result of genetic interaction that occurs between the parents. The combination of coat colors from two different types of cattle can produce mixed colors (combinations), thereby creating color variations in the offspring [1]. This finding supports previous research by Trifena et al. [32] and Dhita [7], which showed that white fur is the dominant color in PO cattle. Additionally, Mawitjere et al. [19] identified that the qualitative characteristics of male PO cattle show that 67% have solid white fur, while the remaining 33% have a combination of fur or a white-grayish color. This finding confirms that the white coat color is the main characteristic of male PO cattle, while variations in color, such as gray, reflect diverse genetic influences.

In the Villages Breeding Center (VBC), 84.40% of male Peranakan Ongole Cattle (PO) display black muzzles, with the remaining 15.60% displaying mixed muzzle colors. The dominance of the black muzzle color has become one of the distinctive phenotypic characteristics of male PO cattle in the region. The findings agree with Trifena et al (2011), which indicates that PO cattle generally have black muzzles. Furthermore, Mawitjere et al. [19] assert that the black muzzle color in male PO cattle is a trait that exhibits dominant genetic diversity. This emphasizes that the black muzzle color is one of the important traits in the identification and selection of male PO cattle.

The research results in the Peranakan Ongole (PO) cattle breeding area show distinctive phenotypic characteristics. The color of the upper lip in male PO cattle is predominantly black at 48.60%,

while the lower lip is mainly a mixed color at 43.10%. Additionally, the eyelashes and the hair color at the tip of the tail in male PO cattle are consistently 100% black. Another observed characteristic is that 60.60% of male PO cattle have horns, 100% have dewlap, and 92.70% have hump. Male PO cattle generally have phenotypic characteristics such as the presence of horns, dewlap, and hump. This finding confirms that these characteristics play a significant role in the morphological identity of male PO cattle, serving as a valuable reference for genetic selection programs and enhancing cattle quality in the breeding source regions [7].

PO cattle generally have distinctive phenotypic characteristics. These characteristics include body colors that range from white to gray, tails with black tips and fur around the eyes, large bodies, a long dewlap that extends from the neck to the back of the front legs, and large humps on bull's and small humps on cow's. In addition, PO cattle have short necks, small ears that stand upright to the sides, and elongated heads with horns [31]. The Indonesian National Standard 7651.5:2020 [5] confirms these characteristics, explaining that PO cattle exhibit a dominant white color on their neck and shoulders, with color variations ranging from grayish to black. Other characteristics of PO cattle include a large body, a long dewlap, a large hump on the male cattle, a short neck, an elongated head, small ears that stand upright to the side, black tail hair and skin around the eyes, and a primarily black muzzle. The combination of these characteristics makes PO cattle one of the types of cattle with superior phenotypes, in accordance with the standards and morphological identification that can support the development program of superior breeds in Indonesia.

Karakteristik Morfometrik Sapi Peranakan Ongole Jantan

The use of a morphometric approach as an analytical method, research includes determining the characteristics of Sahiwal cattle by measuring sizes such as chest circumference, body length, horn circumference, horn length, and tail length [35, 17], determining the specific characteristics of the cattle breed by conducting principal component analysis [17]. Observation of PO cattle was conducted based on the morphometric characteristics of 109 male cattle. The results of the quantitative analysis of PO cattle data based on body morphometric characteristics are presented in Table 4.

Table 4. Body Measurement of Male Peranakan Ongole Cattle (Mean±SD)

Age	n	Variabel						
		Body weight (Kg)	Withers height (cm)	Body length (cm)	Chest girth (cm)	Chest depth (cm)	Hip height (cm)	Hip width (cm)
PI 0	40	156.41±28.42[a]	110.97±5.78 [a]	107.45±7.75 [a]	126.92±7.51 [a]	51.28±4.72 [a]	117.20±5.59 [a]	29.42±2.65 [a]
PI 2	36	220.26±36.90[b]	119.58±5.00 [b]	117.67±8.12 [b]	143.19±7.98 [b]	58.00±5.35 [b]	125.69±6.07 [b]	33.14±3.13 [b]
PI 4	12	306.33±52.00[c]	132.08±7.88 [c]	129.17±6.82 [c]	161.33±9.26 [c]	64.50±6.33 [c]	138.17±7.71 [c]	38.25±3.02 [c]
PI 6	9	416.33±28.56[d]	135.67±5.07 [c]	139.56±12.29[d]	175.11±7.75 [d]	73.00±4.58 [d]	144.67±6.48 [d]	42.89±1.36 [d]
PI 8	12	525.17±45.15 [e]	143.17±2.40 [d]	156.83±7.33 [e]	191.42±5.88 [e]	79.17±4.28 [e]	150.33±4.16 [d]	51.00±1.48 [e]
Total	109	256.06±125.89	121.72±12.35	121.30±17.74	147.17±22.80	59.82±10.56	128.23±13.00	35.11±7.38

a,b,c,d,e Different superscripts on the same column indicate significant differences in the age groups of the cattle (p<0.05); PI = Permanent Incisivi; SD = Standard Deviation

The results of the study on the morphometric characteristics of male PO cattle in Napis Village, Tambakrejo District, Bojonegoro Regency, East Java, show significant variation based on age groups (aged <1 year, 1–1.5 years, 1.5–2 years, 2–3 years, aged > 3.5 years). The average (mean) data and standard deviation (SD) of the body size of male PO cattle across all variables indicate a significant difference (P<0.05) between the age groups. One of the main parameters that shows a significant increase is body weight. The average body weight of male PO cattle consistently increased from aged <1 year (156.41±28.42 kg) to its peak at aged > 3.5 (525.17±45.15 kg). This increase illustrates an optimal growth pattern according to age group, as visualized in Figure 2. This finding offers a comprehensive overview of the morphometric development of male PO cattle, serving as a valuable reference for breeding and development programs, particularly in regions that serve as sources of superior breeding stock.

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Differences in age groups among PO male cattle show a significant difference (P<0.05) in body weight, with a positive correlation between body weight and age. This reflects the natural growth process of cattle, where body weight tends to increase with the age of male PO cattle. This increase indicates that PO cattle have a regular growth pattern, which is an important basis for maintenance and breeding management. Various factors influence the differences in body weight of male PO cattle, including environmental factors [16, 18, 33], the duration or time of maintenance [8], as well as the maintenance system[24, 34]. Additionally, feed management factors, such as the quality and quantity of feed, significantly influence the weight of cattle [27, 28]. Genetic factors also have a significant influence on body weight variation [3, 16]. The combination of these factors becomes the main element in determining the success of the breeding and development program for PO male cattle in various regions, including the breeding source areas.
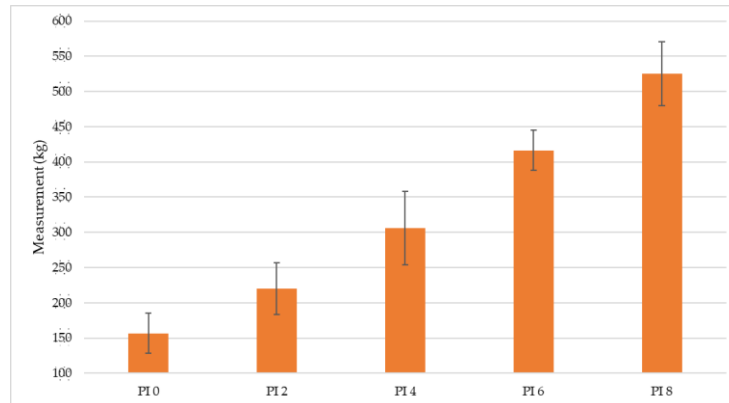

Figure 2. Body Weight of Male PO Cattle in Napis Village

The research showed that the withers height, body length, and chest circumference of male PO cattle significantly increase with age (Figure 3). The withers height of male cattle increased from 110.97±5.78 cm in the <1-year age group to 143.17±2.40 cm in the >3.5-year age group. However, in cattle aged 1.5–2 years and 2–3 years, no significant difference was found in the height of the withers (P > 0.05). Meanwhile, the body length showed a significant increase (P<0.05) from 107.45±7.75 cm in the <1-year age group to 156.83±7.33 cm in the >3.5-year age group. The chest circumference also increased significantly, from 126.92±7.51 cm in the <1-year age group to 191.42±5.88 cm in the >3.5-year age group. The increase in withers height, body length, and chest circumference as the age of the cattle increases indicates normal and optimal physical growth. The research showed that the withers height, body length, and chest circumference tend to increase with age [12]. The chest circumference and body length of PO cattle are also known to have a positive correlation with carcass weight [26], indicating that these parameters can be important indicators for estimating the body weight and carcass weight of cattle [30]. Physiologically, an increase in chest circumference reflects the increased capacity of the cattle body to accommodate larger vital organs, which supports weight gain and metabolic efficiency. In addition, chest circumference, withers height, and body length can be used as indicators of the skeletal size or frame of cattle, which is one of the selection criteria in the breeding of PO cattle [20]. This indicates that these morphometric parameters are not only relevant for describing growth but also for supporting the evaluation of cattle quality in the context of breeding and meat production.
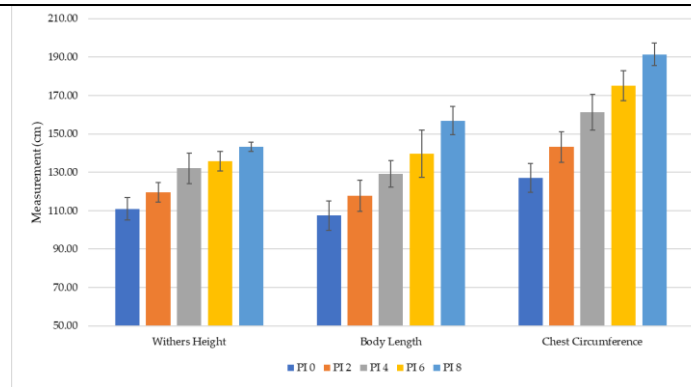
Figure 3. Withers Height, Body Length and Chest Circumfences of Male

The research found that the hip height, hip width, and chest depth in male PO cattle experience significant growth as they age, as shown in Figure 4. The superscript differences in each age group ($P<0.05$) indicate a significant difference between these age groups. The hip height of male PO cattle increased from 117.20 ± 5.59 cm in the age group <1 year to 150.33 ± 4.16 cm in the age group >3.5 years. The age group <1 year to 2–3 years showed significant growth ($P<0.05$), while no significant difference was found between the age groups 2–3 years and >3.5 years, indicating stability in hip height growth in adulthood. The hip width of male PO cattle also showed a consistent increase, from 29.42 ± 2.65 cm in the age group <1 year to 51.00 ± 1.48 cm in the age group >3.5 years. Significant differences ($P<0.05$) between age groups with different superscripts indicate that the growth of hip width occurs consistently throughout the growth period. The chest depth of male PO cattle increased from 51.28 ± 4.72 cm in the age group <1 year to 79.17 ± 4.28 cm in the age group >3.5 years. Significant differences between age groups ($P<0.05$) with different superscripts confirm consistent growth in this parameter as age increases. Overall, the growth of hip height, hip width, and chest depth in male PO cattle reflects optimal body development and consistency with age. The stability of hip height growth in adulthood indicates that this parameter peaks at a certain period, while hip width and chest depth continue to increase, indicating a growing body capacity. This finding is important for the morphometric evaluation of male PO cattle in the context of breeding and maintenance, particularly in supporting programs to improve genetic quality and livestock productivity.
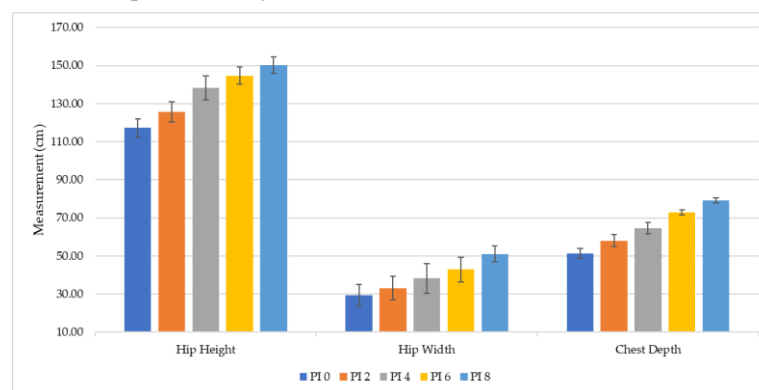

Figure 4. Hip Size and Chest Depth of Male PO Cattle in Napis Village

Growth is the individual's ability to optimize their genetic potential in body development until reaching maturity, which is the result of the interaction between genetic and environmental factors [22]. In the context of Peranakan Ongole (PO) cattle, morphometric characteristics such as withers height, body length, chest circumference, hip height, hip width, and chest depth have a strong correlation with body weight across various age categories [21, 23]. This correlation makes morphometric parameters very useful in estimating cattle body weight [37]. In addition to being a tool for estimating body weight, morphometric characteristics also play an important role in the identification and differentiation between cattle breeds, such as PO cattle, Bali cattle, and Brahman crosses [6]. This information is not only relevant for breeding purposes but also supports livestock management based on its

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morphological advantages, which can ultimately enhance production efficiency and the genetic quality of cattle.

4. Conclusions

It can be concluded from the research findings that male PO cattle at Napis Village, Tambakrejo District, Bojonegoro Regency, East Java meet the Indonesian National Standard (SNI) 7651.5:2020 for PO cattle beef cattle breeding. The morphometric characteristics of male PO cattle, such as body weight, withers height, body length, chest circumference, hip height, hip width, and chest depth, show a significant increase in size with age. This finding reflects an optimal growth pattern and can serve as a reference in the selection and development program for the quality of PO cattle breeding in Indonesia.

5. Acknowledgment

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