Morphological characterization of Burkina Faso local pig

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Abstract

In this study, we conducted a comprehensive analysis of indigenous pig populations in Burkina Faso's Central region, with the aim of understanding their morphological and qualitative characteristics, genetic diversity, and implications for local pig farming. We employed a variety of methods, including morphometric measurements, principal component analysis (PCA), hierarchical clustering, and linear discriminant analysis, to investigate these aspects. Our findings revealed significant sexual dimorphism among the pigs, with females generally displaying broader thoracic perimeter. Moreover, there was substantial morphological diversity among pigs from different localities, suggesting likely adaptations to specific environmental conditions and breeding practices. Through PCA, we highlighted the complex interplay of morphometric traits contributing to this diversity. Hierarchical clustering analysis categorized the pig population into three distinct clusters, each associated with unique morphological traits and geographic origins, hinting at the presence of different genetic types or breeding practices. However, linear discriminant analysis indicated that gene flow and exchange among communities play a significant role in shaping the population. Qualitative traits such as coat color, tusks, coat patterns, and others underscored the diversity within the pig population. Notably, a shift in coat color distribution was observed, potentially due to crossbreeding with exotic pig breeds.

Key words: Pig, morphometric, region, gene flow, Burkina Faso

Caractérisation morphologique du porc de race locale du Burkina Faso

Résumé

Cette étude a porté sur les populations de porcs autochtones de la région centrale du Burkina Faso. Notre objectif était de comprendre leurs caractéristiques morphologiques et leur diversité génétique. Pour cela, nous avons utilisé diverses méthodes, dont des mesures morphométriques, une analyse en composantes principales (ACP), une classification hiérarchique et une analyse linéaire discriminante. Nos résultats ont révélé un dimorphisme sexuel marqué, avec des circonférences thoraciques généralement plus larges chez

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les femelles. De plus, nous avons constaté une grande diversité morphologique entre les porcs de différentes communes de la région du Centre, suggérant des adaptations aux conditions locales et aux pratiques d'élevage spécifiques. L'ACP a mis en évidence la complexité des caractéristiques morphométriques contribuant à cette diversité. La classification hiérarchique a donné trois groupes distincts, associés à des caractéristiques morphologiques uniques et à des origines géographiques différentes, suggérant l'existence de différents types génétiques ou de pratiques d'élevage. Cependant, l'analyse discriminante linéaire a montré l'importance des échanges génétiques entre les différentes populations. Les caractéristiques qualitatives, comme la couleur de la robe, les défenses et les motifs, ont également souligné la diversité au sein de la population porcine. Cette étude apporte des informations précieuses en génétique animale et a des implications pratiques pour l'élevage dans la région.

Mots clefs : Porc, Morphométrique, région, flux de gènes, Burkina Faso.

Introduction

At a global scale, the livestock sector assumes an average share of 43% within the agricultural Gross Domestic Product (GDP), thereby significantly underpinning the livelihoods and nutritional security of nearly one billion individuals. Across diverse African nations, this contribution spans a range of 30% to 80% (FAO, 2018). In the context of Burkina Faso, livestock comprises approximately 10% to 20% of the GDP, while also contributing about 30% to the nation's export earnings, positioning it as the second-largest contributor to the augmented agricultural value following cotton (FAO, 2019). Notably, the swine industry occupies a crucial position concerning sustenance security, socio-cultural dynamics, and economic facets, particularly within regions of the south where religious inhibitions surrounding pork consumption are limited. These intertwined elements collectively underscore pig farming's substantive role in addressing food scarcity and impoverishment challenges prevalent within Burkina Faso. Among the spectrum of pig breeds reared, the indigenous variety holds preeminence, constituting approximately 97% of the total porcine populace, despite its zootechnical performance lagging behind that of exotic counterparts (FAO, 2012). This ascendancy attributed to local pig husbandry emanates from its remarkable adaptability to demanding rearing conditions, adept management of waste resources (DJIMENOU *et al.*, 2017), and the elevated organoleptic attributes of its meat (AGBOKOUNOU *et al.*, 2016).

In recent years, the introduction and subsequent crossbreeding of exotic breeds with native pigs have engendered a perpetual susceptibility to genetic attrition. In contemporary Burkina Faso, this phenomenon has instigated a diverse spectrum of porcine genetic strains, the defining traits of which remain inscrutable (DJIMENOU *et al.*, 2017). Beyond the advancements facilitated by judicious husbandry practices, encompassing nutritional equilibrium and vigilant health surveillance, the zootechnical proficiency of indigenous pigs can be invigorated via the avenue of selective breeding and hybridization. However, the enhancement of the genetic potential of local breeds and their nuanced contribution toward the formulation of sustainable management paradigms necessitate a precedent cognizance of their phenotypic makeup (FAO, 2013) and morpho-biometric variances. In Burkina Faso, a notable gap exists in the morphological characterization of local pig breeds. Most Existing research predominantly concentrates on the economic profitability of local pigs (UMUTONI, 2012). The objectives of this study is to ascertain the extent of morphological heterogeneity within the pig population in Burkina Faso and to provide indications of potential gene flow between these populations.

I. Material and methods

I.1. Study area

The investigation was carried out in the Kadiogo province, situated in the central region of Burkina Faso. This study encompassed all six rural communes within the province, namely Saaba (SAB), Pabré (PAB), Komsilga (KMS), Tanghin Dassouri (TGHD), Komki-Iipala (KKI), and Koubri (KB) (figure 1). The Kadiogo province falls within the Sudano-Sahelian climatic zone, characterized by a tropical climate with two distinct seasons: an extended dry season prevailing from October to May, followed by a shorter rainy season extending from May to October. The mean annual precipitation over the past decade has averaged 700 ± 150 mm. The average annual temperature registers at 33°C, encompassing a range of minimum temperatures between 18°C and 20°C (December/January) and maximum temperatures spanning 37°C to 42°C (March/April).

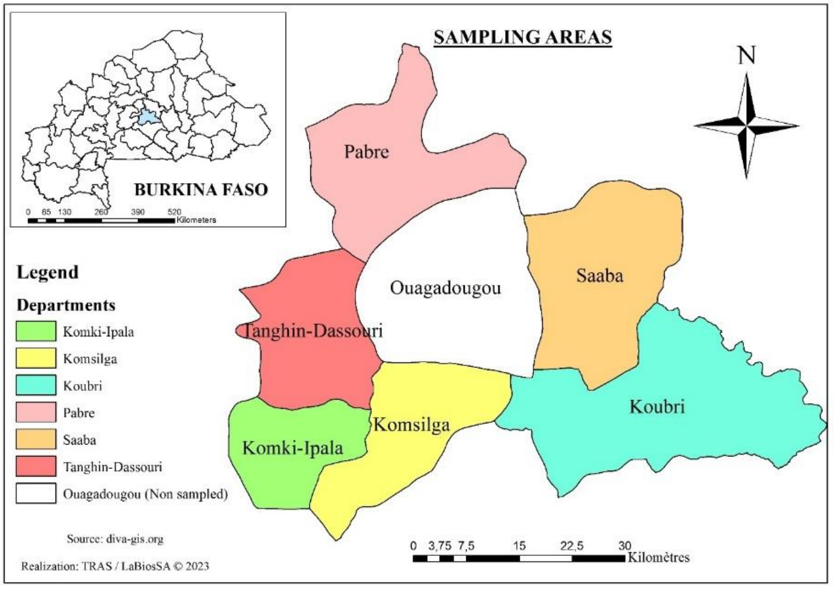

Figure 1: Sampling areas

I.2. Sampling method

The sampling method utilized was a snowball approach, initiated with three "seed" breeders in each of the six (06) communes across the peri-urban zones of Ouagadougou, chosen for their rearing of local pigs. Following this, additional farmers were identified and included in the cohort through referrals from these seed participants. To ascertain the unrelatedness of the sampled animals, interviews were conducted with each farmer. From each participating flock, a maximum of three adult pigs, each over the age of 10 months, were sampled. This procedure resulted in the collection of a total of 115 adult pigs (30 males and 91 females) from an aggregate of 50 breeders.

I.3. Morphological parameters

Body measurements and qualitative traits were assessed following the guidelines outlined by the Food and Agriculture Organization of the United Nations (FAO) for the characterization of Animal Genetic Resources (FAO, 2013). In total, 30 distinct traits were recorded, encompassing 19 linear body measurements and 11 qualitative traits. The linear body measurements were conducted using a zootechnical measuring stick of approximately one meter and a Wintape® brand zoometer tape measure. Measurements encompassed both head and body dimensions, including muzzle circumference (MC), neck circumference (NC), Body Length (BL), head length (HL), ear length (EL), tail length (TL), head width (HW), hip width (HW), chest girth (CG), hock girth (HG), and paunch girth (PG), the length of the circumference of the pelvic region just in front of the hip, performed using the zoometer tape. Measurements involving wither height (WH), back height (BH), rump height (RH), chest depth (CD), Belly depth (BD), chest width (CW), and shoulder width (CW) were obtained using the zootechnical measuring stick. Each animal was gently restrained while taking the measurements.

I.4. Qualitative parameters

The qualitative characteristics, including head profile (a: concave, b: convex, and c: straight), ear type (a: hanging, b: semi-drooping, c: erect, and d: drooping), ear orientation (a: forward, b: backward, and c: upward), presence of tusks, backline (a: concave, b: convex, and c: straight), coat pattern (a: solid, b: piebald, and c: spotted), coat color (1: white, 2: black, 3: dark red, 4: light red, 5: fawn, 6: gray), tail type (a: straight, b: curly), muzzle shape (a: short and cylindrical, b: long and slender), skin texture (a: smooth, b: wrinkled), and hair type (a: long and dense, b: long and sparse, c: short and dense, d: short and sparse), were assessed through direct visual observation of the individual.

I.5. Data analysis

Raw data collected through surveys were input into Microsoft Excel spreadsheets, where an initial data cleaning process was executed. This process involved the removal of aberrant records and the exclusion of variables containing missing and/or aberrant data. The resultant dataset from the initial cleaning was transformed into a text file and imported into R 3.6.0 software. Subsequently, the dataset underwent normalization via Z-scores, and outliers were subsequently eliminated. The analysis encompassed a total of 106 individuals, 19 quantitative variables, and 2 qualitative variables. Quantitative data were depicted using least square means values and the standard error of the mean. Variability in morphometric traits was evaluated across different localities and between sexes utilizing a Type III ANOVA, with a significance threshold set at $p<0.05$. Principal Component Analysis (PCA) was performed using the FactoMinerR and factoextra packages within R Studio. PCA facilitated dimensionality reduction, allowing for the exploration of patterns and relationships among variables. Following the assessment of eigenvalues across distinct dimensions, variables (specifically Age, EL) that contributed minimally to the initial two dimensions were omitted to optimize overall inertia in these dimensions. An agglomerative hierarchical clustering analysis (HCA) facilitated the identification of the number of morphotypes existing within the pig population of Burkina Faso's central region. Linear discriminant analysis (LDA) was carried out using the "discrim" package to scrutinize population structure. Finally, the "hglm" package in R Studio was employed to ascertain the impact of locality on all morphometric parameters. For this purpose, a linear model (model = X~Y) featuring the exclusive fixe" eff"ct of locality was employed. The "emmeans" package within R Studio was subsequently utilized to ascertain the least square means and standard errors of each morphological parameter based on locality. Qualitative parameters were represented in the form of frequencies. Comparisons of these frequencies were conducted using the Chi-squared test, with statistical significance set at $p<0.05$. All of these analyses were performed using R software version 3.6.0.

II. Results

II.1. Principal component analysis

The PCA plot depicted in Figure 2 portrays the morphological variation among individuals within our study cohort. No distinct clusters are readily apparent. PC1 (F1) and PC2 (F2), collectively account for 82.5% of the total variance. PC1 emerges as the primary axis accounting for 74% of the total variance. In the individual PCA plot; outliers are noticeable at the plot's periphery.

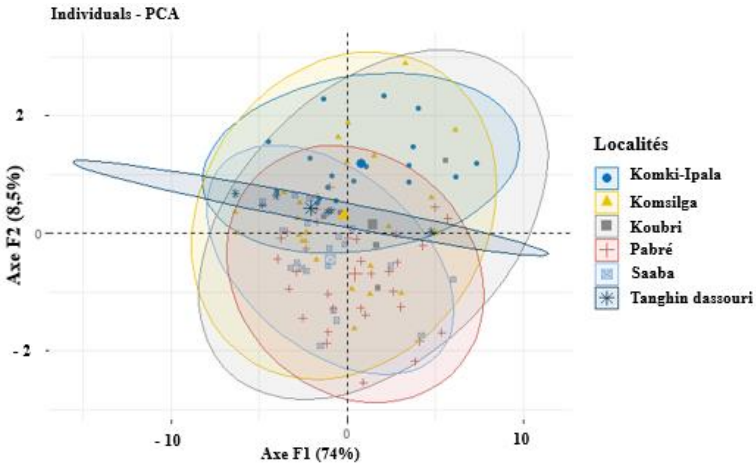

Figure 2: individual PCA plot

Table 1 depicts the contribution of different variables to the first two PCs. PC1 is predominantly influenced by variables including thoracic perimeter, paunch girth, Withers height, Belly depth, Sacrum height, Back height, and Neck circumference. Each displaying significant positive correlation (0.89 to 0.94) to PC1.

Furthermore, Principal Component 2 (PC2) captures a distinct aspect of variability, where Chest depth, Body length, Chest width, Shoulder width, Hip width, Tail length contribute with varying intensities, as indicated by their corresponding loadings (-0.3 to 0.49). The chest depth, the trunk and the tail length exhibit a modest negative association with PC2, contrasting with other variables that demonstrate positive associations.

PC1 predominantly characterizes attributes related to overall body size and proportions, whereas PC2 captures distinct morphological aspects, mainly associated with the trunk.

Table 1: Contribution of the variables to the PCs

Variables	F1 (PC1)	F2 (PC2)
Thoracic perimeter	0.94	–
Belly girth	0.93	–
Withers height	0.92	–
Belly depth	0.91	–
Sacrum height	0.91	–
Back height	0.90	–
Neck circumference	0.89	–
Chest depth	0.89	-0.27
Trunk length	0.82	-0.3
Chest width	0.80	0.49
Shoulder width	0.77	0.44
Hip width	0.74	0.49
Tail length	0.71	-0.46

II.2. Hierarchical classification

The hierarchical classification analysis was conducted to explore the inherent structure within the morphometric data of the studied population. The classification encompassed about 82.5% of the total variability (figure 3). The analysis revealed the formation of three distinct clusters, each representing a morphologically homogeneous group.

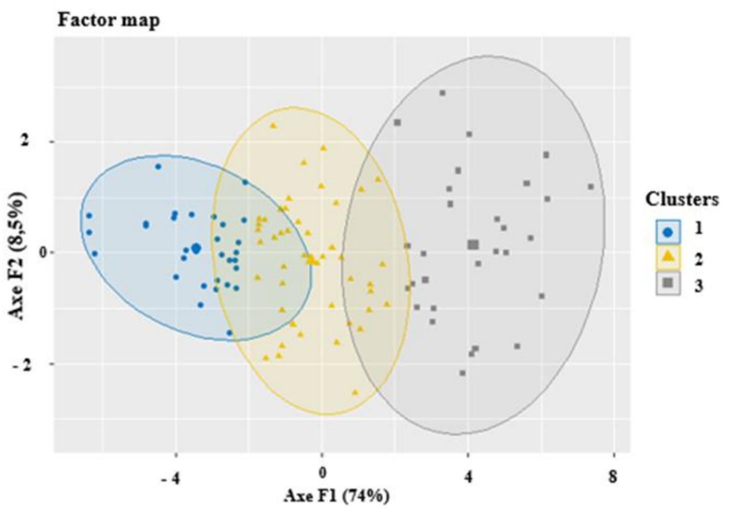

Figure 3: Hierarchical classification clusters

Tables 2 and 3 describe the main characteristics of the clusters obtained after hierarchical classification.

Cluster 1 comprises 31 individuals, with notable representation from various communes. Specifically, 29% of the individuals originated from Komsilga, 22.6% from Pabré, 9.7% from both Koubri and Saaba, and 7.9% from Tanghin dassouri. The cluster's morphometric profile is characterized by specific measurements (table 3). Notably, Cluster 1 paragon presents a body length of 58 cm, indicating an intermediate size. The thoracic perimeter measures 53 cm, indicating moderate thoracic dimensions. The hindquarters and sacrum height are 36.1 cm and 39 cm, respectively, suggesting conservative dimensions. The tail and ear length are 17 cm and 8.4 cm, respectively. The muzzle circumference measures 22 cm, and the trunk length is 19 cm. The belly girth and neck circumference are recorded as 51 cm and 39 cm, respectively. In summary, Cluster 1 individuals exhibit an intermediate body size and proportional morphological traits. (table 3).

Cluster 2 consists of 46 individuals mostly (32.6%) originating from Pabré. Additionally, contributions come from Komsilga (19.6%), Saaba (17.4%), and others (table 2). The morphometric analysis reveals distinctive features within this cluster. Cluster 2 paragon exhibits a body length of 45 cm, making it the shortest among the clusters. Intriguingly, the thoracic perimeter is notably broad at 77 cm. The hindquarters and sacrum height are recorded at 53.4 cm and 56 cm, respectively, indicating a relatively larger physique. The tail measures 18 cm, while the ear length is 9.5 cm. The muzzle circumference is 23 cm, and the trunk length is 20 cm. The belly girth measures 98 cm, and the neck circumference is 55 cm (table 3). In essence, Cluster 2 individuals possess compact proportions with a robust chest and prominent hindquarters.

Cluster 3 individuals are distributed across various communes, with significant contributions from Komsilga (20.69%), Pabré (37.93%), and Saaba (10.34%) (table 2). The morphometric attributes of Cluster 3 are distinctively characterized. Notably, Cluster 3 displays an extensive body length of 74 cm, surpassing the measurements of the other clusters. The thoracic perimeter measures 84 cm, indicating a broad thoracic region. The hindquarters and sacrum height are 51.3 cm and 51 cm, respectively, suggesting harmonious proportions. The tail is 24 cm long, and the ear length measures 13 cm. The muzzle circumference records 28.5 cm, while the trunk length is 23 cm. The belly girth measures 90 cm, and the neck circumference is 64 cm. In summary, Cluster 3 individuals display substantial body size and balanced proportions (table 3).

Table 2: Distribution percentages of Clusters Across Different Communes

	Communes					
Cluster	Komki	Komsilga	Koubri	Pabré	Saaba	TGHD
1	9,7	29	0	22.6	29	9.7
2	17,4	19.6	8.7	32.6	17.4	4.3
3	24.14	20.69	3.45	37.93	10.34	3.45
Total	16.98	22.64	4.72	31.13	18.87	5.66

TGHD : Tanghin Dassouri

Table 3: clusters paragon morphometric

Clusters	TL	TP	WH	SH	TL	EL	MC	HL	BG	NC
1	58	53	36.1	39	17	8.4	22	19	51	39
2	45	77	53	56	18	9.5	23	20	98	55
3	74	84	51	51	24	13	28.5	23	90	64

TL : Trunk length; TP: Thoraci Perimeter; WH : Withers Height; SH : Sacrum Height; TL : Tail Length; EL : Ear Length; MC: Muzzle Circumference; HL: Head Length; BG: Belly Girth; NC: Neck Circumference

II.3. Linear discriminant analysis

Within the morphometric context, the distinct localities offer valuable insights into the distribution of genetic types as determined by linear discriminant analysis (table 4). In Komki-Ipala, the analysis demonstrates a robust classification accuracy, with 85% of individuals being correctly assigned to their genetic type, and an additional 5% predicted as belonging to the Komsilga genetic type. Meanwhile, Komsilga exhibits a dominant prediction accuracy of 78.26% within its own genetic type, while 13.04% are classified as Pabré and 4.35% as the Saaba genetic type. A smaller subset (4.35%) falls into the TGHD genetic type. Similarly, in Koubri, the majority (80%) aligns with the predicted Koubri genetic type, while the remaining 20% lacks specific genetic type assignment. Pabré showcases an accurate 78.79% prediction of its genetic type, with 12.12% projected to be Komsilga and 6.06% as Saaba genetic types; notably, a minor fraction (3.03%) remains unassigned (table 4). In Saaba, the classification is notably strong, accurately identifying 85% of individuals as belonging to the Saaba genetic type, and 10% to the Pabré genetic type, with the residual 5% assigned to TGHD. For the TGHD locality, an appreciable 60% representation aligns with the TGHD genetic type, with an equivalent 20% prediction in Komki-Ipala and Komsilga genetic types, while the remainder remains unassigned.

Table 4: Linear discriminant analysis predictions

Genetic types	Predicted genetic types (%)						
	Komki-Ipala	Komsilga	Koubri	Pabré	Saaba	TGHD	N
Komki-Ipala	**85**	5	0	5	0	5	20
Komsilga	0	**78.26**	0	13.04	4.35	4.35	23
Koubri	0	0	**80**	20	0	0	5
Pabré	0	12.12	3.03	**78.79**	6.06	0	33
Saaba	0	0	0	10	**85**	5	20
TGHD	20	20	0	0	0	**60**	5

TGHD: Tanghin Dassouri, N:size

II.4. Morphometrics parameters

Among the sampled individuals, the majority were females, constituting 80% in Saaba (n=20), 72.22% in Komki-Ipala (n=18), 80.77% in Komsilga (n=26), 66.67% in Tanghin Dassouri (n=6), 70.59% in Pabré (n=34), and 72.72% in Koubri (n=11). The average age of the pigs included in this study was 13.5 months, with ages ranging from 10 months to 4 years.

The quantitative measurements obtained from the sampled animals are succinctly presented in Table 5. This table displays the least square means and standard errors for each body measurement, categorized by locality and sex. An in-depth analysis of variance (Type III ANOVA) was conducted, accounting for both geographical zones and sex to evaluate the various body measurements. The disparity among the least square means reveals a noteworthy trend: boars consistently exhibit significantly reduced mean values ($p<0.05$) compared to sows across all quantified traits. The exceptions to this pattern include withers, back, and sacrum height, muzzle circumference, ear length, and hock circumference, where no statistically significant differences were detected (table 5). Among the observed trends, females tend to possess a more extensive thoracic perimeter (70.39±1.24 cm) than their male counterparts (62.87±2.07 cm). This observation underscores a distinct sexual dimorphism that favors the female population.

The analysis further reveals variations across localities. Individuals sampled in Koubri exhibit the highest values for back height (47.92±3.11 cm), chest depth (23.74±1.99 cm), belly depth (26±2.29 cm), thoracic perimeter (76.2±5.03 cm), belly girth (82.6±6 cm), shoulder width (14.12±1.23 cm), head length (25.76±1.33 cm), body length (69.8±4.77 cm), tail length (22.4±1.53 cm), and ear length (11±0.67 cm). Similarly, individuals from Komki-Ipala stand out with higher measurements in chest width (15.66±0.73 cm), hip width (18.86±0.74 cm), and neck circumference (49.16±1.92 cm). Conversely, the Pabré populations display distinctively notable figures for sacrum height (46.44±1.21 cm), muzzle circumference (25.89±0.57 cm), spiral girth (81.84±2.12 cm), and hock circumference (10.25±0.24 cm) (table 1). Additionally, the Saaba pig populations exhibit the greatest average head width (10.63±0.32 cm), while individuals from Tanghin Dassouri consistently yield the smallest measurements for all studied characteristics, except for shoulder width, chest, hip, ear length, and head length.

Table 5: Least squares means ± standard error of quantitative traits. by sampling area and sex

Parameters[1]	Sampling areas						Sex	
	KOMKI	KOMS	KOUB	PABRE	SAABA	TGHD	Female	Male
Withers Height	44.33±1.57	41.65±1.36[a]	45.42±2.97	43.92±1.16	41.56±1.49	40.33±2.71	43.63±0.74	40.85±1.24
Back Height	46.32±1.64	45.72±1.42	47.92±3.11	47.34±1.21	41.41±1.56*	41.4±2.84	45.99±0.81	43.65±1.35
Sacrum Height	44.85±1.63	43.17±1.41	45.9±3.1	46.44±1.21	41.29±1.55	39.65±2.83	44.71±0.8	42.21±1.33
Head Width	10.4±0.34	10.02±0.29	9.9±0.65	9.94±0.25	10.63±0.32	8.5±0.59*	10.26±0.17	9.59±0.28*
Shoulder Width	11.89±0.65	9.97±0.56*	14.12±1.23	9.77±0.48**	9.19±0.61**	9.57±1.12	10.77±0.32	8.84±0.54**
Chest Width	15.66±0.73	13.02±0.64**	13.56±1.39	12.13±0.54***	11.61±0.7***	11.63±1.27**	13.41±0.37	11.36±0.61**
Hip Width	18.86±0.74***	15.11±0.64***	15.7±1.4*	14.12±0.54***	12.71±0.7***	13.37±1.27***	15.48±0.4	13.34±0.67**
Chest Depth	20.97±1.05	2155±0.91	23.74±1.99	22.5±0.78	21.44±1	18.87±1.82	22.36±0.49	19.78±0.82**
Belly Depth	23.76±1.21	25.05±1.05	26±2.29	25.27±0.89	24.35±1.15	20.79±2.09	25.58±0.55	21.74±0.92***
Thoracic Perimeter	69.54±2.65	69.95±2.3	76.2±5.03	68.95±1.96	65.33±2.51	59.67±4.59	70.39±1.24	62.87±2.07**
Belly Girth	77.87±3.16	77.73±2.74	82.6±6	78.62±2.34	73.43±3	68.25±5.48	79.98±1.41	68.36±2.36***
Spiral Girth	81.14±2.87	76.56±2.49	50.1±5.45***	81.84±2.12	76.58±2.73	71.3±4.98	80.91±1.41	67.77±2.36***
Hock Girth	10.06±0.32	9.79±0.28	10.06±0.61	10.25±0.24	9.64±0.3	8.5±0.55*	9.98±0.16	9.64±0.26
Muzzle Circumference	24.07±0.77	23.23±0.66	23.8±1.45	25.89±0.57	23.87±0.73	23.08±1.33	24.58±0.38	23.66±0.63
Neck Circumference	49.16±1.92	48.35±1.66	46.42±3.64	48.29±1.42	45.83±1.82	42.53±3.32	48.62±0.9	44..64±1.5*
Head Length	25.47±0.7	22.33±0.61**	25.76±1.33	23.94±0.52	23.15±0.67*	23.17±1.22	24.11±0.35	22.68±0.58*
Body Length	65.83±2.51	59.16±2.18*	69.8±4.77	69.09±1.86	64.45±2.38	57.25±4.35	66.21±1.25	60.79±2.08*
Ear Length	10.86±0.35	10.49±0.31	11±0.67	10.98±0.26	10.08±0.34	11.25±0.61	10.71±0.17	10.66±0.29
Tail Length	20.28±0.8	19.29±0.7	22.4±1.53	22.12±0.59	19.8±0.76	17.67±1.39	21.03±0.4	18.98±0.66**
Age	17.33±2.2*	10.88±1.91	9.6±4.18	14.48±1.63	13.8±2.09	9.33±3,81	15,1±1,03	9,04±1,72**

1 : In cm except for age

KOMKI: Komki-Ipala, KOMS: Komsilga, TGHD: Tanghin Dassouri

II.5. Qualitative parameters

The analysis of Table 6 suggests significant phenotypic diversity among local pigs in the Central region of Burkina Faso. Indeed, various coat colors were identified, with the most common being white (60%) and black-and-white piebald (28.7%). Regardless of the rural commune and within the breed, these white and black-and-white piebald coats were more prevalent, while fawn and fawn-and-white coats were rare. The observed coat patterns were solid (54.7%), spotted (40.9%), or piebald. Three head profiles were determined: concave, convex, and straight. The head generally exhibited a straight profile (62.6%) ending with a predominantly long and slender snout (55.6%). In the majority of cases (60%), tusks were absent. Long and dense fur predominated (70.4%) with mostly wrinkled skin (70.4%). Two tail types were observed: straight (37.4%) and corkscrew-shaped (62.6%). The dorsal line was predominantly straight (62.6%). The most common individuals in the Central region of Burkina Faso have a white coat (60%), smooth skin (70.4%), a uniform pattern (54.7%) with long and dense fur (70.4%), a corkscrew-shaped tail (62.6%), a straight head profile (62.6%) with upright and upward-oriented ears (58.3%), ending with a long and slender snout (55.6%).

Table 6: Frequencies of the qualitative traits

		Sampling areas						sex		
Traits	**Modalities**	**KOMKI**	**KOMS**	**Koubri**	**Pabré**	**Saaba**	**TGHD**	**F**	**M**	**Total**
N		**18**	**26**	**11**	**34**	**20**	**6**	**86**	**29**	**115**
Coat Color	White	72.2	69.2	81.8	44.1	45	83.3	62.8	51.7	60
	White fawn	0	0	0	2.9	5	0	1.2	3.4	1.8
	White gray	0	0	0	2.9	10	0	2.3	3.4	2.6
	Pie Black	27.8	23.1	18.2	35.3	35	16.7	26.7	34.5	28.7
	Fawn	0	0	0	2.9	0	0	1.2	0	0.9
	Gray	0	0	0	5.9	5	0	2.3	3.4	2.6
	Black pie	0	3.8	0	0	0	0	1.2	0	0.9
	Black Gray	0	3.8	0	5.9	0	0	2.3	3.4	2.6
Tusks	Present	50	30.8	36.4	50	35	16.7	44.2	27.6	40
	Absent	50	69.2	63.6	50	65	83.3	55.8	72.4	60
Coat Pattern	Uniform	72.2	53.84	81.8	44.1	50	33.3	41.7	51.7	54.7
	spotted	22.2	42.31	18.2	50	45	66.7	29.6	44.8	40.9
	Pie	5.6	3.85	0	5.9	5	0	1.2	3.4	4.4
Muzzle	Short & cylindrical	5.6	34.6	9.1	67.7	35	66.7	41.9	51.7	44.4
	Long & slender	94.4	65.4	90.9	32.3	65	33.3	58.1	48.3	55.6
Fur	Short sparse	27.8	30.8	27.3	0	10	33.3	15.1	24.2	17.4
	Short dense	27.8	3.8	0	0	5	0	7	3.4	6.1
	Long dense	33.3	57.7	72.7	94.1	80	66.7	70.9	69	70.4
	Long sparse	11.1	7.7	0	5.9	5	0	7	3.4	6.1

N: Sample size, KOMKI: Komki-Ipala, KOMS: Komsilga, TGHD: Tanghin Dassouri.

Ear orientation	Forward	28	15	27	6	5	33	12.8	20.7	14.8
	Backward	0	19	9	44	50	0	23.3	37.9	26.9
	Upward	72	65	64	50	45	67	63.9	41.4	58.3
Skin appearance	Smooth	55.6	65.4	100	55.9	95	83.3	72.1	65.5	70.4
	Wrinkled	44.4	34.6	0	44.1	5	16.7	27.9	34.5	29.6
Tail type	Straight	61.1	30.8	63.6	11.8	45	50	34.9	44.8	37.4
	Corkscrew	38.9	69.2	36.4	88.2	55	50	65.1	55.2	62.6
Backline	Straight	22.2	69.2	90.9	61.8	65	100	62.8	61.1	62.6
	Saddled	77.8	30.8	9.1	38.2	35	0	37.2	37.9	37.4
Head profile	Straight	11.1	65.4	90.9	70.6	65	100	62.8	62.1	62.6
	Convex	88.9	34.6	9.1	26.5	30	0	36	34.5	35.6
	Concave	0	0	0	2.9	5	0	1.2	2.9	1.8
Ear type	Erect	100	100	100	100	100	100	100	100	100

III. Discussion

III.1. Morphometric

The results of this study are multifaceted and provide critical insights into the morphological characteristics of local pig populations in Burkina Faso.

The analysis highlights a significant sexual dimorphism, with female pigs constituting most of the sampled population in various localities. This dimorphism is particularly evident in the thoracic perimeter, where females consistently exhibit broader measurements compared to males. Comparable sexual dimorphic patterns have been previously documented in a study conducted in Benin (DJIMENOU *et al.*, 2018).

The study underscores striking disparities in morphometric traits observed among pigs from Koubri. They exhibit markedly higher measurements in multiple traits, including back height, chest depth, belly depth, thoracic perimeter, belly girth, shoulder width, head length, body length, tail length, and ear length. These findings strongly imply a unique local adaptation phenomenon within the Koubri pig population. This distinctive adaptation may arise from a combination of environmental factors and region-specific breeding practices. Indeed, it's noteworthy that Koubri is situated in the peri-urban area of Ouagadougou, characterized by a thriving intensive livestock industry, often featuring exotic breeds. The prevalence of such intensive practices and the influence of exotic breeds may contribute significantly to the observed morphological differences in Koubri's pig population. This adaptation likely reflects a response to the specific demands and challenges of intensive farming systems, which prioritize certain traits for enhanced productivity. In stark contrast, pigs from Tanghin Dassouri exhibited the smallest body measurements. This aligns with observations reported by YAMEOGO in 2021 and may be attributed to the highly traditional nature of livestock practices prevalent in the region.

III.2. Principal Component Analysis and hierarchical classification

The absence of pronounced clustering in the individual PCA (Principal Component Analysis) plot indicates a nuanced and intricate pattern of variation within the studied pig population, likely arising from a complex interplay of genetic and environmental factors. It may be important to add that the differences observed earlier are attributable to a few specific variables. However, these differences tend to be masked when considering the entire set of variables in the PCA. This suggests that while certain individual traits may exhibit notable variations, these variations become less apparent or even obscured when analyzing the population as a whole across the broader spectrum of variables included in the PCA. This highlights the complexity and diversity within the population that are not immediately apparent when examining individual variables in isolation. This multifaceted pattern of variation aligns with findings from similar studies conducted in Benin (DJIMENOU *et al.*, 2017, 2018), where pigs exhibited a similarly continuous range of morphological diversity rather than distinct clusters. Notably, our analysis identified specific variables that strongly influence the observed morphological variation. PC1, for instance, was predominantly influenced by variables such as thoracic perimeter, Belly girth, Withers height, Belly depth, Sacrum height, Back height, and Neck circumference. These variables collectively suggest that core aspects of the pigs' physique significantly contribute to the observed variation.

The clustering analysis conducted in this study has unveiled significant insights into the morphological diversity within the examined pig population. This analysis led to the identification of three distinct clusters, denoted as Cluster 1, Cluster 2, and Cluster 3, primarily based on body measurements and geographical origins. These clusters, which were derived through hierarchical classification, are underpinned by noticeable morphometric features, as elucidated by their respective paragons. The amalgamation of cluster analysis and paragon data furnishes a comprehensive panorama of the morphological diversity and adaptive strategies prevalent among the indigenous pig populations inhabiting the studied communes. It is noteworthy that while Cluster 2 and Cluster 3 share certain communes in common, particularly Pabré, Komsilga, and Saaba, they manifest discernible distinctions in terms of their morphological characteristics. These discrepancies underscore the influence of additional factors, potentially encompassing genetic diversity and divergent breeding practices within these regions. Indeed, these variations might be the outcome of deliberate selections made by local breeders in their pursuit of more high-performing animals, as previously observed by HOUNDONOUGBO *et al.* (2010). Furthermore, it is important to acknowledge that the paragon values obtained in this study are comparatively lower than those reported by DJIMENOU (2018) in Benin, RITCHIL *et al.* (2014) in Bangladesh, and TINALAOU (2020) in Cameroon. These disparities may arise from intrinsic genetic variations across different geographic regions, as well as the specific breeding objectives and selection pressures imposed by local husbandry practices.

III.3. Linear discriminant analysis

In light of our results, individuals belonging to various observed morphotypes are randomly distributed across the six rural communes. This phenomenon can be attributed not only to the proximity between the localities, which share the same agro-ecological zone, but also to socio-cultural practices. Acts of gifting, ceremonies, and local customs are factors that promote the movement of animals from one locality to another. Likewise, the flow of animals between pig farmers, between farmers and pig traders, between farmers and pork processors, between traders and processors, and between farmers/traders and consumers (NONFON, 2005) are reasons that explain the random distribution of different local pig populations in the study area. With only 60% of pigs correctly classified, the pig population of Tanghin Dassouri appears to be the least stable. It is characterized by a high variability in its phenotype, which is reclassified into other populations, particularly that of Komki-Ipala (20%) and Komsilga (20%). Pigs from Komki-Ipala are also reclassified in Komsilga (5%) and Tanghin Dassouri (5%). This suggests that pigs from Tanghin Dassouri are involved in shaping the pig populations of Komsilga.

III.4. Qualitative parameters

The description of qualitative characteristics revealed a diversity of coat colors within the local pig population in the Central region of Burkina Faso. Various coat colors have been previously reported in Burkina Faso, with black being the dominant color (MRA, 2003; KIENDREBEOGO, 2006; UMUTONI, 2012). Additionally, studies from other regions, particularly in Asia and Europe, have reported over 95% prevalence of black coat color in native pigs (BORO *et al.*, 2016; RITCHIL *et al.*, 2014; ZAMAN *et al.*, 2013). However, the results of this study indicate a significant decrease in the frequency of black coat color among the local pigs in the Central region of Burkina Faso, with white, black-and-white piebald, and black piebald coats becoming more prominent. This suggests that the observed color diversity may be the result of color dilution or loss due to crossbreeding between local pigs, typically black, and exotic pigs such as the Large White breed, which is known for its white coat and is raised extensively in Burkina Faso due to its relative adaptation to tropical climates. This breed has become one of the most commonly raised exotic pig breeds in Burkina Faso and could be contributing to the observed frequency of white coat and mixed coat colors among local pigs in the Central region. Similar findings were reported in Benin (DJIMENOU *et al.*, 2018). Regarding ear characteristics, head shape, and snout type, these traits align with those found in previous studies in Benin (DJIMENOU *et al.*, 2018; YOUSSAO *et al.*, 2018). However, in India, different ear orientations, including erect, horizontal, and drooping ears, were observed (BORO *et al.*, 2016). This morphological variation reflects the molecular genetic diversity among local pig populations from different countries (DJIMENOU *et al.*, 2018). Like in Burkina Faso, in Benin, Concave head profile, and curly tails has also been reported in improved and crossbred pigs (YOUSSAO *et al.,* 2018).. These phenotypes observed in the pig population of the Central region are likely the result of crossbreeding between local pigs, which typically have straight tails, and crossbred pigs, which often have curly tails. The presence of dense, sparse, and long hair observed in some local pigs is consistent with observations in Ghana, particularly in the Ashanti local pig breed, where dense hair is found on the pig's back and sparse hair on the sides (ALENYOREGE *et al.*, 2015). Similar results have been reported by other authors (UMUTONI, 2012) in African local pigs. As for the assessment of the dorsal line, it was predominantly straight in local pigs, consistent with observations in Benin (YOUSSAO *et al.*, 2018), Ghana (ALENYOREGE *et al.*, 2015), and Nigeria (ADEOLA *et al.*, 2013). In summary, for most qualitative traits, our results are in line with those found by other authors (KIENDREBEOGO, 2006; UMUTONI, 2012; ADEOLA *et al.*, 2013; ALENYOREGE *et al.*, 2015; DJIMENOU *et al.*, 2018; SOMENUTSE *et al.*, 2019). These findings suggest that the morphological characteristics of local pigs in Burkina Faso may be undergoing color dilution or loss of other qualitative traits due to crossbreeding with other pig breeds.

Conclusion

In conclusion, this study offers valuable insights into the morphological and qualitative attributes of indigenous pig populations in Burkina Faso's Central region. Our findings underscore a notable sexual dimorphism, with female pigs generally exhibiting broader thoracic perimeter. Furthermore, significant morphological diversity across various localities suggests potential adaptations to distinct environmental conditions and breeding practices. The principal component analysis (PCA) underscores the complex interplay of various morphometric traits contributing to this diversity. Through hierarchical clustering analysis, we have identified three distinct clusters (Cluster 1, Cluster 2, and Cluster 3), each associated with unique morphological traits and geographic origins. These clusters suggest the presence of discrete genetic types or breeding practices within the region. However, linear discriminant analysis reveals that pigs from different localities exhibit random distribution, indicating a possible substantial gene flow and exchange among communities. Qualitative traits, encompassing coat color, tusks, coat patterns, muzzle shape, fur type, ear orientation, skin texture, tail type, backline, and head profile, further emphasize the diversity within the pig population. The shift in coat color distribution, with a reduction in black and an increase in white and piebald patterns, potentially signifies the influence of crossbreeding with exotic pig breeds.

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