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ISOTOPE RATIOS OF BIOELEMENTS FOR INFERRING BEEF ORIGIN AND ZEBU FEEDING REGIME IN CAMEROON

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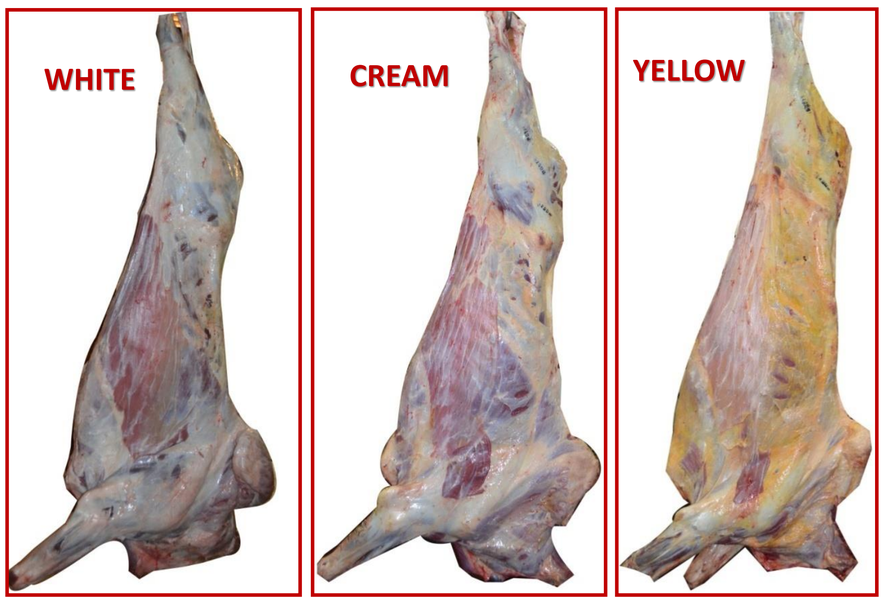
I. INTRODUCTION

The aim of the study was to deal with a lack of knowledge regarding the stable isotope composition of beef from zebu cattle reared in tropical Africa and its variability due to geographical distribution and animal feeding system.



The three-level scale used for the visual assessment of the subcutaneous fat colour.

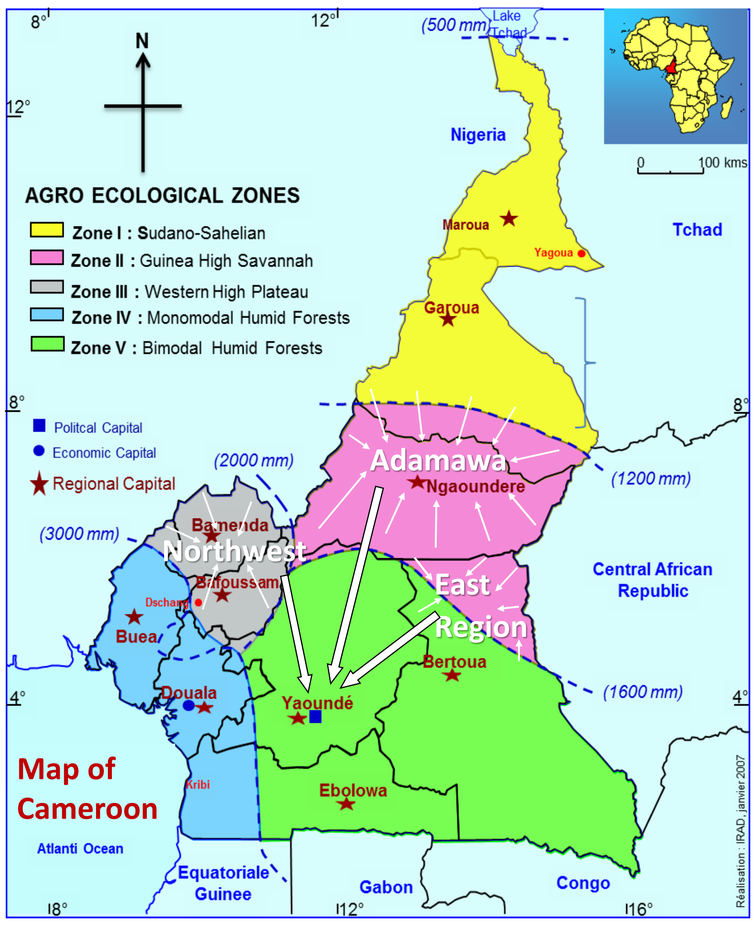
II. MATERIAL AND METHODS

Sixty beef carcasses belonging to the most popular zebu breeds (Goudali, White Fulani and Red Mbororo) were selected and sampled at the slaughter house of Yaounde, Cameroon.

The cover fat colour of the carcass was visually evaluated, using a three-level qualitative scale (white, cream or yellow).

Before slaughtering, the geographical and ecological origin of the cattle was carefully recorded. The Republic of Cameroon has an estimated cattle population of 6.5 million heads farmed in ten administrative regions and five ecological zones. The experimental cattle originated from Adamawa (Guinean high savannah), Northwest (Western high plateaus) and East Region (Guinean high savannah).

After chilling, a sample of ***Longissimus dorsi*** **muscle (LM)** was taken for stable isotope ratios measurement of five bio-elements - H, O, C, N and S - in fat and defatted (protein) fractions and fatty acid analysis.



III. RESULTS AND DISCUSSION

Stable isotope ratios of LM fractions (DFDM: defatted dry matter; FAT: crude fat) in relationship with geographical origin and subcutaneous fat colour (^{A,B,C}: P≤0.01; ^{a,b,c}: P≤0.05).

		$\delta^{13}C$ [‰]DFDM	$\delta^{13}C$ [‰]FAT	$\delta^{2}H$ [‰]DFDM	$\delta^{2}H$ [‰]FAT	$\delta^{18}O$ [‰]DFDM	$\delta^{18}O$ [‰]FAT	$\delta^{15}N$ [‰]DFDM	$\delta^{34}S$ [‰]DFDM
Total	Mean	**-11.8**	-17.8	**-62.8**	-179.5	**17.3**	23.6	**4.68**	**7.91**
	SD	1.22	1.86	4.99	8.08	0.78	1.42	0.78	0.86
Region	Adamawa	**-11.5**	-17.6 ^{AB}	**-62.5**	-180.5	**17.4**	23.6 ^{B}	**4.46** ^{b}	**7.84** ^{b}
	Northwest	**-12.6**	-19.6 ^{B}	**-61.6**	-176.4	**17.1**	22.1 ^{C}	**5.56** ^{a}	**8.75** ^{a}
	East	**-11.9**	-17.1 ^{A}	**-64.8**	-178.6	**17.2**	24.8 ^{A}	**4.68** ^{b}	**7.35** ^{b}
Fat colour	White	**-12.4**	-19.2 ^{A}	**-61.8**	-173.9 ^{B}	**17.4**	23.3	**5.11**	**8.30**
	Cream	**-11.7**	-18.0 ^{AB}	**-63.5**	-178.2 ^{AB}	**17.3**	23.7	**4.66**	**7.74**
	Yellow	**-11.4**	-16.6 ^{B}	**-62.7**	-184.9 ^{A}	**17.3**	23.6	**4.39**	**7.80**

1

Zebu beef from Cameroon has higher $\delta^{13}C$, $\delta^{2}H$ and $\delta^{18}O$ values than those reported in other world areas, as a consequence of feeding on tropical C4 pasture grasses and of geographic and climatic gradient in the isotope composition of precipitation water.

The isotopic composition of muscle fat fraction was affected by the colour of cover fat. Zebu with white cover fat ("white type") were more enriched in ^{2}H and more depleted in ^{13}C isotopes than "yellow type", while "cream type" was in-between.

Results of the best reclassification of beef samples from zebu of different geographical origin on the basis of the linear discriminant functions calculated from the stable isotope data (% of correctly classified observations).

2

The individual isotope ratio variability was influenced by the regional origin of beef. The canonical discriminant analysis of the bio-elements' isotopic profile allowed corrected allocation of 81.7% of beef samples and corrected origin cross-validation of 75% of individual samples. Four isotopes significantly contributed to trace beef origin, in this order: $\delta^{15}N_{DFDM}$; $\delta^{34}S_{DFDM}$; $\delta^{18}O_{FAT}$; $\delta^{2}H_{DFDM}$.

	Region	Predicted beef origin		
		Adamawa	Northwest	East
Original	Adamawa	**75.0**	12.5	**12.5**
	Northwest	**.0**	100.0	**.0**
	East	**.0**	10.0	**90.0**
Cross-validated	Adamawa	**65.0**	17.5	**17.5**
	Northwest	**.0**	100.0	**.0**
	East	**.0**	10.0	**90.0**

3

It was argued that, as a consequence of better nutritional status, the "yellow types" had a more diluted phospholipid (PL) content and a higher proportion of neutral lipids (NL) in their fat in comparison with the "white types", and thus a less negative $\delta^{13}C_{FAT}$ value, in agreement with the findings that PL fraction displays a more negative diet-tissue fractionation than NL fraction.

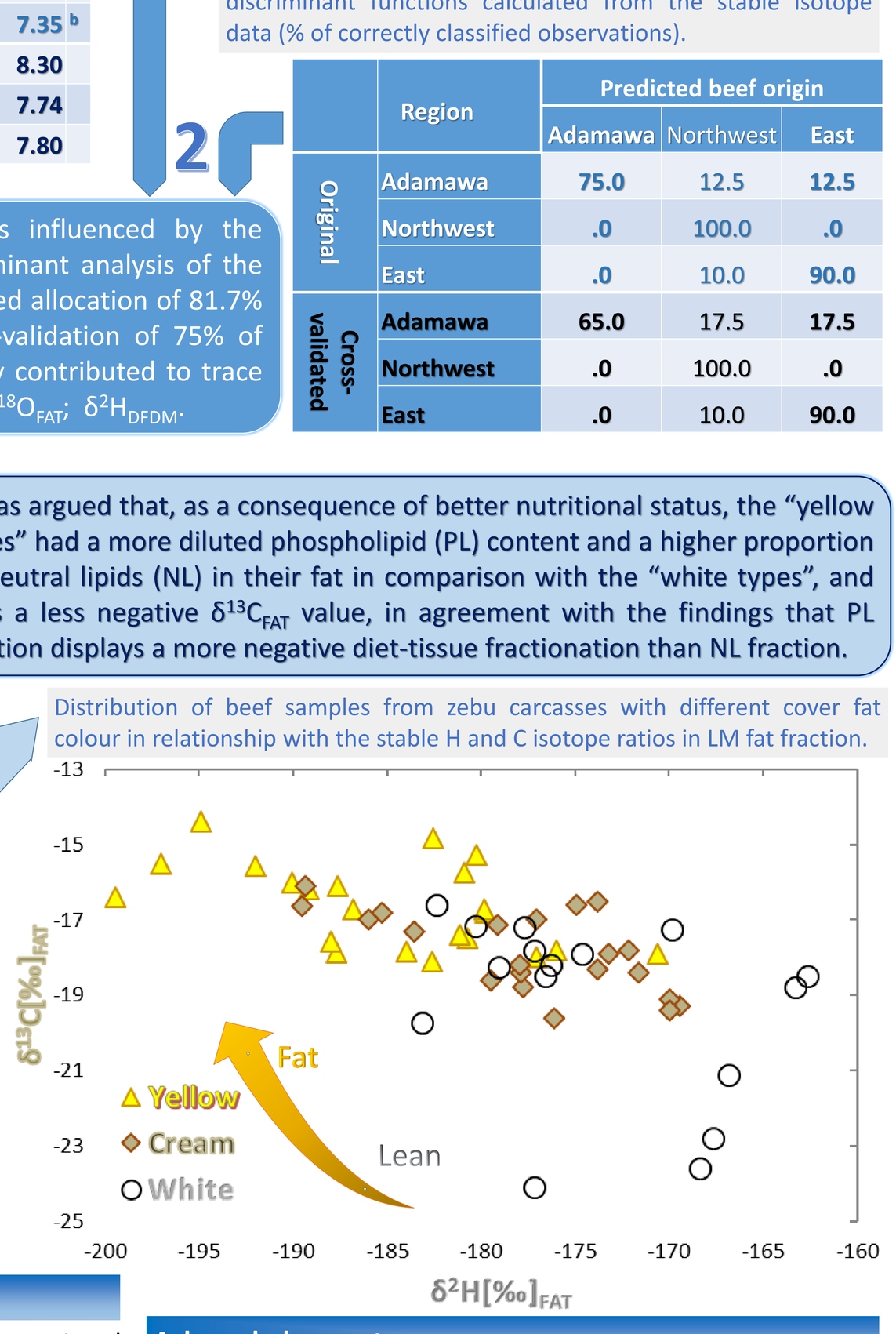
These trends correlated with fat composition: ^{2}H enrichment and ^{13}C depletion were significantly correlated with a high PUFA content, while ^{2}H depletion and ^{13}C enrichment were correlated with a high SFA content.

Relationship of LM fat content (Total lipids, TL, % dry matter) and fatty acid profile (%TL) with subcutaneous fat colour and isotope composition of LM fat fraction.

Cover fat colour	WHITE	CREAM	YELLOW	MSE	CORRELATION	
					$\delta^{2}H[‰]_{FAT}$	$\delta^{13}C[‰]_{FAT}$
no. samples	16	22	22			
Total lipids	3.3^{b}	4.1^{b}	7.1^{a}	2.61	-.478**	.413**
SFA	47.1^{b}	49.5^{ab}	52.2^{a}	5.12	-.514**	.335**
MUFA	33.1^{b}	35.3^{b}	38.3^{a}	4.21	-.315 *	.273 *
PUFA-n3	6.4^{a}	5.0^{b}	3.2^{c}	1.57	.655**	-.466**
PUFA-n6	13.4^{a}	10.2^{b}	6.2^{c}	3.50	.675**	-.506**
PUFA	19.8^{a}	15.2^{b}	9.4^{c}	4.95	.665**	-.483**

**: P≤0.01; ^{a,b,c} or *: P≤0.05

Distribution of beef samples from zebu carcasses with different cover fat colour in relationship with the stable H and C isotope ratios in LM fat fraction.



IV. CONCLUSIONS

Within Cameroon, multi-element analysis provided promising results for tracing the regional origin of beef and some aspects of the cattle breeding system, such as the animal's nutritional status.

Acknowledgement

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