FACTORS AFFECTING THE COMPOSITION OF LONG-CHAIN FATTY ACIDS IN THE AFRICAN BUFFALO (*SYNCERUS CAFFER*)

by

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ABSTRACT

The proportions of long-chain fatty acids in *M. Longissimus dorsi* (LD), subcutaneous (SCF), perirenal (PRF), pericardial (PCF) and omental (OMF) fat and the effects of age, gender and area on the proportions of long-chain fatty acids in these fat depots of the African buffalo were studied. Buffalo meat is an important commodity for tourists to the Kruger National Park (KNP) and the composition, colour and amount of carcass fat contributes significantly towards its quality. Previous research suggests significant breed, age, gender and anatomical differences in the composition of fatty acids in various domestic ruminant species. Little information is available on the composition of carcass fat in wild ruminants like the African buffalo. The LD, SCF, PRF, PCF and OMF depots were sampled from buffalo culled in three different areas in the KNP i.e. Mashatudrif at Houtboschrand (MH) (Mopane/Bushwillow woodlands on granite), Mthandanyathi at Lower Sabie (MLS) (thorn thickets on granite) and Mpanamana Dam at Crocodile Bridge (MD) (Knob thorn/Marula savannah on basalt). Samples were sterilised and stored at –20°C for subsequent lipid extraction with chloroform:methanol (2:1 v/v). Butylated hydroxy toluene (BHT) was included as an antioxidant. Fatty acids were measured by gas chromatography and expressed as a proportion of total long-chain fatty acids (w/w %).

Significant differences ($P<0.01$) were found in unsaturated (UFA) and saturated (SFA) fatty acids between the external (SCF and LD) and internal (PRF, PCF) fat depots. LD differed significantly ($P<0.01$) from OMF. Fatty acids from SCF and LD did not differ significantly ($P<0.01$). SCF and LD differed significantly ($P<0.01$) from PRF for the proportions of C13:0, C16:0, C16:1 and C18:1. The fatty acids present in PRF, PCF and OMF did not differ significantly, except for C16:1 being significantly ($P<0.01$) higher in PRF than OMF.

Age differences were noted for C13:0 (decreased in LD ($P<0.01$), C14:0 (increased in SCF ($P<0.01$)), C15:0 (decreased in PRF, OMF, PCF ($P<0.01$)), C16:0 (decreased in PRF ($P<0.01$) and PCF ($P<0.05$)), C18:0 (increased in SCF ($P<0.01$) and LD ($P<0.05$)), C18:1 (increased in SCF ($P<0.05$)), C18:3 (decreased in SCF ($P<0.05$)). The proportions of SFA and UFA did not change significantly with age. The proportions of UFA differed significantly between females and males and in particular C16:1 and C18:1 in SCF and LD. Significant differences ($P<0.05$) in the proportions UFA in SCF were found of buffalo's from different areas. Higher proportions of UFA were observed in animals from the MH than animals from MLS, while that of animals from MD was intermediate. Differences in the proportions of C13:0, C15:1, C16:0, C17:0 and C18:0 were noted between different buffalo herds sampled. Buffalo from MLS contained significantly higher proportions ($P<0.01$) of C13:0 compared to those from the other two areas. The internal fat depots appeared to be more stable, compared to the external depots and were not significantly influenced by area. The results suggest that area, age and gender significantly affected the composition of long-chain fatty acids in fat depots of the African buffalo and that the energy reserves of buffalo are progressively depleted during the dry winter season to meat the requirements for maintenance, growth and lactation.

OPSOMMING

Die verspreiding van langketting vetsure in *M. Longissimus dorsi* (LD), onderhuids (OHV), perirenaal (PRV), perikardaal (PKV) en omentum (OMV) vet en die effek van ouderdom, geslag en gebied op die verspreiding van vetsure in die vetreserwes van die Afrika buffel, is bestudeer. Buffelvleis is 'n belangrike kommoditeit vir toeriste wat die Nasionale Krugerwildtuin (NKW) besoek en die samestelling, kleur en hoeveelheid karkasvet dra betekenisvol by tot die kwaliteit van die eindproduk. Vorige navorsing dui op betekenisvolle verskille in ras, ouderdom, geslag en anatomiese lokalisasie ten opsigte van die samestelling van vetsure in verskillende plaasdierspesies. Min inligting is egter beskikbaar oor die samestelling van karkasvet in wilde herkouerspesies soos die Afrika buffel. Monsters is geneem van die LD, OHV, PRV, PKV en OMV vetreserwes van uitskot buffels van verskillende areas in NKW, naamlik Mashatudrif by Houtboschrand (MH) (Mopanie/Boswilger-bosveld op graniet), Mthandanyathi by Onder-Sabie (MLS) (doringveld op graniet) en Mpanamana-dam by Krokodilbrug (MD) (Knoppiesdoring/Maroela savanne op basalt). Monsters is gesteriliseer en by –20°C geberg vir daaropvolgende lipiedekstraksie met chloroform:methanol (2:1 v/v). Butielhidroksietoleen (BHT) is as anti-oksidant ingesluit. Vetsure is bepaal deur gaschromatografie en uitgedruk as 'n persentasie van die totale vetsuurinhoud (m/m %). Die resultate dui daarop dat gebied, ouderdom en geslag 'n betekenisvolle invloed op die samestelling van langketting vetsure in vetsreserwes van die Afrika buffel het. Betekenisvolle verskille is waargeneem ($P<0.01$) tussen die onversadigde (OVS) en versadigde (VVS) vetsure, tussen die eksterne (OHV en LD) en interne (PRV, PKV) vetreserwes. LD het betekenisvol verskil van OMV. Vetsure van OHV en LD het nie betekenisvol ($P<0.01$) verskil nie. OHV en LD het wel betekenisvol ($P<0.01$) verskil van PRV ten opsigte van C13:0, C16:0, C16:1 en C18:1. Die vetsure teenwoordig in PRV, PKV en OMV het nie betekenisvol verskil nie, behalwe in die geval van C16:1 wat wel betekenisvol ($P<0.01$) hoër was in PRV en OMV. Ouderdomsverskille is waargeneem ten opsigte van C13:0 (afname in LD ($P<0.01$)), C14:0 (toename in OHV ($P<0.01$)), C15:0 (afname in PRV, OMV en PKV ($P<0.01$)), C16:0 (afname in PRV ($P<0.01$) en PKV ($P<0.05$)), C18:0 (toename in OHV ($P<0.01$) en LD ($P<0.05$)), C18:1 (toename in OHV ($P<0.05$)) en C18:3 (afname in OHV ($P<0.05$)). VVS en OVS het nie betekenisvol verander met ouderdom nie. OVS het betekenisvol verskil tussen vroulike en manlike diere veral ten opsigte van C16:1 en C18:1 in OHV en LD. Betekenisvolle verskille ($P<0.05$) in OVS in die OHV is gevind in buffels van verskillende areas. Hoër verhoudings van OVS is waargeneem by diere van MH as by diere van MLS en MD. Verskille in C13:0, C15:1, C16:0, C17:0 en C18:0 is waargeneem by buffels in genoemde areas. Buffels van MLS het betekenisvol meer C13:0 ($P<0.01$) gehad as die buffels in die ander twee areas. Die interne vetreserwes kom meer stabiel voor as die onderhuidse vetreserwes en is nie betekenisvol deur die area beïnvloed nie. Die huidige resultate dui op 'n uitputting van energiereserwes om te voldoen aan die behoeftes vir onderhoud, groei en laktasie as gevolg van swak voedingstoestande gedurende die droë winter seisoen.

I declare that this thesis for the degree M.Sc. (Agirc) at the University of Pretoria has not been submitted by me for a degree at any other university.

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SUMMARY

The most important fatty acids in buffalo fat are C18:1, C18:0, C16:0 and C13:0. In the internal fat depots C18:1 was the most abundant fatty acid and was not influenced by age, gender or area. In subcutaneous fat (SCF) and muscle, C18:1 was the second most abundant fatty acid, since C13:0 was present in the highest proportions. Proportions of C18:1 increased with age and was higher in females than in males. The proportions of C13:0 was significantly higher in SCF and *M. Longissimus dorsi* (LD) than in the internal fat depots. It was highest in males, especially those from Mashatudrif at Lower Sabie (MLS) and Mpanamana dam at Crocodile Bridge (MD), with animals from MLS containing significantly higher proportions than those from Mtandanyathi at Houtboshrand (MH). Proportions of C18:0 increased with age and was highest in females and in buffalo sampled near MH. By contrast the proportion of C16:0 was higher in internal fat than SCF and LD, and highest in females. These results suggest that C16:0 is mobilised from the more labile energy stores, SCF and LD in all animals from MLS and MD during the depletion of adipose tissue due to poor nutritional status.

Keywords: long-chain fatty acids, African buffalo, age, gender, area, depot fat

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LIST OF ABBREVIATIONS

A	Buffalo calves and juveniles under 2 years of age
AMP	Adenosine monophosphate
AOAC	Association of Official Analytical Chemists
ATP	Adenosine triphosphate
B	Subadult buffalo between 2 and 6 years of age
BHT	Butylated hydroxy toluene
C	Adult buffalo older than 6 years of age
CO_2	Corbon dioxide
FAME	Fatty acid methyl ester
FFA	Free fatty acids
FMD	Foot and mouth disease
GC	Gas chromatograph
GLM	General linear Models
HDL	High-density-lipoprotein
KNP	Kruger National Park
LD	*M. Longissimus dorsi*
LDL	Low-density-lipoprotein
MD	Mpanamana dam at Crocodile Bridge
MH	Mtandanyathi at Houtboshrand
MLS	Mashatudrif at Lower Sabie
w/w %	Molar percentage
NADH	Nicotine adenine dinucleotide
NADPH	Nicotine adenine dinucleotide phosphate
NKW	Nasionale Krugerwildtuin
OHV	Onderhuidse vet
OIED	Onderstepoort Institute for Exotic Diseases
OMF	Omental fat
OMV	Omentum vet
OVI	Onderstepoort Veterinary Institute
OVS	Onversadigde vetsure
PCF	Pericardial fat
PKV	Perikardiale vet
PRF	Perirenal fat

PRV	Perirenale vet
PUFA	Polyunsaturated fatty acids
rpm	Revolutions per minute
SAS	Statistical Analysis System
SCF	Subcutaneous fat
SD	Standard deviation
SFA	Saturated fatty acids
TB	*Tuberculosis bovis*
TCA	Tricarboxylic acid cycle
UFA	Unsaturated fatty acids
VLDL	Very-low-density-lipoprotein
VVS	Versadigde vetsure

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