PREDICTION OF SOME CARCASS COMPONENTS OF FATTENED BARKI LAMBS USING PRINCIPAL COMPONENTS TECHNIQUES

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SUMMARY

The present study examined the use of principal components techniques for some live body measurements to predict some carcass components of fattened Barki male lambs. The study was carried out during 1997 at Borg El-Arab Experimental Station, which belongs to the Agricultural Research Center, Ministry of Agriculture and is located some 40 km west of Alexandria, Egypt. Fifty Barki male lambs with an average initial live body weight of 26 kg were included in the study. Eight linear live body measurements were taken before slaughtering. Carcass traits were carcass weight (CWT), total weight of the prime cuts (TPC), total weight of secondary cuts (TSC), percentages of prime cuts and secondary cuts TPC and TSC as a percentage from CWT (PCP and SCP) and logs of TPC and TSC (LogP and LogS). Principal components (PC) techniques were used to summarize the variations between different eight live body measurements into one measurement called body size (BZ). BZ was calculated by multiplying the elements of the first eigenvector of the first PC by each body measurement. Simple regression analysis of different carcass traits on BZ was done. The eight studied variables used presented significant statistical correlation ($p < 0.05$) and the first two PC's of them explained 70 % of the total variance. The regression coefficients of CWT, TPC, TSC, PCP, SCP, LogP and LogS were 0.11 kg, 0.06 kg, 0.05 kg, -0.005 %, 0.06 %, -0.00005 Log and 0.0007 Log, respectively. It could be concluded that, principal components techniques summarized the variation in body measurements into two principal components that accounted for 70% of variation in the dependency structure. The first principal component provided a measure of the general body size. The increases of TPC and TSC contributed 55% (60 g) and 45% (50 g), respectively, to the increase of CWT (110 g). The regression coefficients of the TPC and TSC after transformed data to Log_{10} were almost zero.

Keywords: Barki lambs, regression, prime cuts, second cuts

INTRODUCTION

Barki is one of the three major sheep breeds of Egypt. About one million heads of this breed are maintained along the North Western Coastal Area (NWCA) (MOALR, 2004), out of which 300-350 thousand weaned male lambs may be produced yearly. The breed is characterized by small body size and good adaptation to the arid and semi-arid conditions prevailing in that area. Productivity of such animals is rather

low, but this may constitute a part of the ecological balance for the ecosystem. Flock owners tend to get rid of lambs soon after weaning at 3-4 months usually with the advent of the dry season. If these male lambs were properly fattened, they would be expected to produce an extra 6000 tons of lambs/year with better carcass quality (Younis, 1998).

Principal components analysis is a technique used to summarize most of the variation in a multivariate system in fewer variables. In practice, one usually knows from earlier studies, the nature of the data, or even the pattern of components which of these variables have large and distinct variance that could be extracted from variation system. The number of components might be computed until some arbitrarily large proportion (75 % or more) of the variance has been explained. If that proportion cannot be explained by the first 4 or 5 components, it is usually fruitless to continue extracting more vectors. In this case, the characteristics of the latter components, may be difficult, if not impossible, to interpret (Morrison, 1976). The present study examined the use of principal components technique for some live body measurements to predict some carcass components of fattened Barki male lambs.

MATERIALS AND METHODS

Lambs and feeding groups

The present study was carried out at Borg El-Arab Experimental Station, which belongs to the Agricultural Research Center and is located some 40 km west of Alexandria, during 1997, as a part of a project which was financially supported by the National Councils, Agriculture Research Center. Fifty Barki male lambs with an average live body weight and age of 26 kg and 180 days, respectively, were included in this study. Lambs were equally divided at random into five feeding groups as follows.

1. Barley grains + grazing natural pasture (8 hr/day) (G1).
2. Barley grains + barseem hay *ad libtum* (G2)
3. Concentrate feed mixture 14% protein + barseem hay *ad libtum* (G3).
4. Barley grains + concentrate feed mixture 14% protein + molasses + *Acacia Saligna ad libtum* (G4).
5. Barley grains + concentrate feed mixture 14% protein + molasses + *Acacia Saligna* irrigated with untreated sewage water during cultivated period *ad libtum* (G5).

Fresh water was available twice daily for all experimental groups. Also, salt blocks were available to all animals. When the lambs reached 45 kg average live body weight, they were fasted overnight and weighed then slaughtered.

Body measurements

Live linear body measurements were taken before slaughtering using a plastic measuring tape and included:

1. Body length, front of shoulder to hook bones (BL).
2. Heart girth, circumference of chest (HG).
3. Height at withers (HW).
4. Height at shoulder (HS).
5. Tail length (TL).

6. Tail upper circumference, at the point of attachment with the body (TU).
7. Tail middle circumference, at the thickest portion of the tail (TM).
8. Tail thickness, at the thickest portion of the tail (measured by caliper) (TT).

Younis *et al.* (1999), who used the same data, found no significant ($P<0.05$) differences among the 5 groups in body measurements, so, in all the following statistical analyses the 50 lambs were used as one group.

Carcass components

Carcass traits recorded for each animal were carcass weight (CWT), total weight of the prime cuts (TPC), total weight of secondary cuts (TSC). In addition, TPC and TSC as a percentage of CWT (PCP and SCP) and Log_{10} TPC and Log_{10} TSC (LogP and LogS) were calculated.

Principal components (PC) analysis

PC analysis was used to summarize the variation in different live body measurements into one measurement called body size (BZ). PC analysis was done through the JMP procedure (SAS, 1998). The first principal component (PC_1) of the observations study variables (X) is linear component. PC_1 was used to calculate BZ by multiplying the elements of the first eigenvector times each body measurement as follows:

$$\mathbf{BZ_{ij}=a_{i1}*BL_j+a_{i2}*HG_j+a_{i3}*HW_j+a_{i4}*HS_j+a_{i5}*TL_j+a_{i6}*TU_j+a_{i7}*TM_j+a_{i8}*TT_j},$$

where,

BZ_{ij} is body size, of jth animal, multiplied by i^{th} element of 1^{st} eigenvector;
a_{i1} the 1^{st} element of 1^{st} eginevector;
a_{i2} the 2^{nd} element of 1^{st} eginevector;
a_{i3} the 3^{rd} element of 1^{st} eginevector;
a_{i4} the 4^{th} element of 1^{st} eginevector;
a_{i5} the 5^{th} element of 1^{st} eginevector;
a_{i6} the 6^{th} element of 1^{st} eginevector;
a_{i7} the 7^{th} element of 1^{st} eginevector;
a_{i8} the 8^{th} element of 1^{st} eginevector; and

BL_j HG_j, HW_j, HS_j, TL_j, TU_j, TM_j, TT_jas defined before.

RESULTS AND DISCUSSIONS

Principal components (PC)

Table 1 shows that there were significant ($P<0.05$) correlation coefficients between the 8 study variables. Also, table 2 shows that the first PC of the 8 study variables explains 50 % of the total variance of the body size while the first two PC's explain 70% of the total variance. These coefficients were higher than 34.7 % and 54.2 % for 1^{st} PC and for the first two PC's, respectively, obtained by Santos and Barros (2004) who used the PC technique to summarize ten variables. The 1^{st} PC accounted for variability less than 60% reported by El-Sheikh *et al.* (2000), who used

PC technique to summarize five variables. These results indicate that the 8 study variables were suitable to characterize the body size of fattened Barki male lambs.

Table 1. Correlation coefficients matrix between the eight studied variables

Variables	BL	HG	HW	HS	TL	TU	TM	TT
HG	0.36							
HW	0.50	0.73						
HS	0.45	0.41	0.69					
TL	0.41	0.52	0.50	0.39				
TU	0.43	0.70	0.35	0.41	0.47			
TM	0.32	0.58	0.71	0.60	0.34	0.85		
TT	0.32	0.50	0.53	0.36	0.57	0.53	0.50	

BL =Body length, HG = Heart girth, HW = Height at withers, HS = Height at shoulder, TL=Tail length, TU=Tail upper circumference, TM = Tail middle circumference, TT = Tail thickness.

Table 2. Principal components relative importance in the verified variance justification

Items	Principal component							
	1	2	3	4	5	6	7	8
Variance (V)	3.95	1.62	0.89	0.48	0.38	0.31	0.26	0.10
V explained (%)	50	20	11	6	5	4	3	1
Accumulated (%)	50	70	81	87	92	96	99	100

The values of the last two rows were rounded to the nearest integer.

Table 3 shows the first two PC factor coefficients. The coefficients of the 1st PC were used to calculate the BZ. Figure 1 shows graphical projection of the selected eight variables on the 1st and 2nd PC axis. All study variables were nearest to the two axes and to the origin point (0,0). In this case, variables play higher importance relevance in the variance justification (Blasco, 1996).

Table 3. Principal component (PC) factor coefficients

PC	BL	HG	HW	HS	TL	TU	TM	TT
1st PC	0.58	0.77	0.71	0.50	0.71	0.82	0.69	0.79
2nd PC	0.29	-0.30	0.56	0.76	0.08	-0.44	-0.60	0.01

BL = Body length, HG = Heart girth, HW = Height at withers, HS = Height at shoulder, TL = Tail length, TU = Tail upper circumference, TM = Tail Middle circumference, TT = Tail Thickness.

Carcass components

Figure 2 shows the regression lines of CWT, TPC and TSC in kg on the PC of BZ of fattened Barki lambs. The regressions lines of all these traits were linearly ($P<0.05$) positive. The regression coefficients of CWT, TPC and TSC were 0.11, 0.06 and 0.05 kg, respectively, i.e. when the BZ of the fattened Barki male lambs increased by one unit CWT increased only by 110 g and this increase was divided into 60 g (55%) and 50 g (45%) for TPC and TSC, respectively.

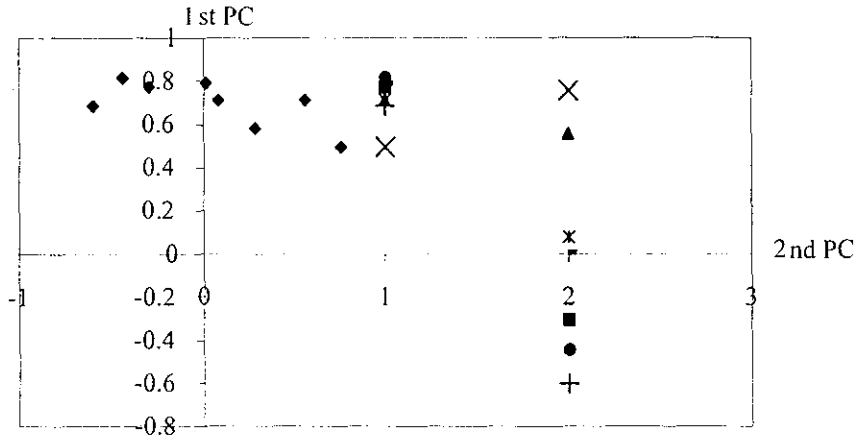

Figure 1. Graphical projection of eight studied variables on the 1st and 2nd principal component axis

BL = Body length, HG = Heart girth, HW = Height at withers, HS = Height at shoulder, TL = Tail length, TU = Tail upper circumference, TM = Tail Middle circumference, TT = Tail Thickness.

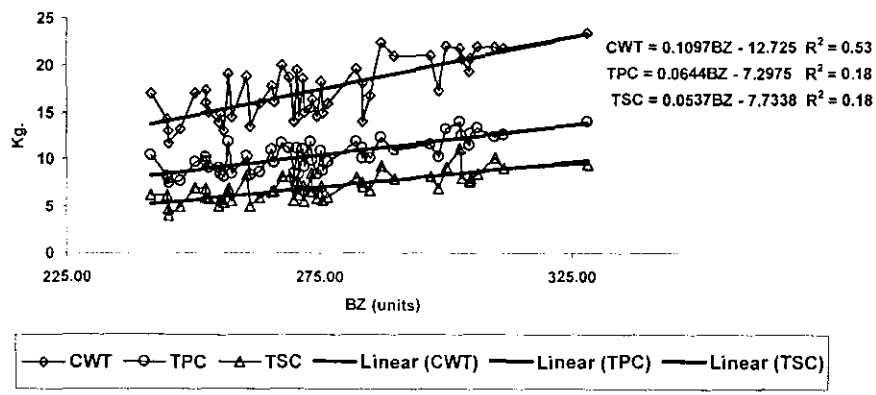

Figure 2. Regression of carcass weight in kg. (CWT), total weight of prime cuts in kg (TPC) and total weight of secondary cuts in kg. (TSC) on principal component of body size (BZ) of fattened Barki lambs

The regression line of PCP, SCP, LogP and LogS on the principal component of BZ of fattened Barki lambs are shown in Figures 3 and 4, respectively. The regression coefficients of PCP, SCP, LogP and LogS were -0.005 %, 0.06 %, -0.00005 log and 0.0007 log, respectively. These regression coefficients were almost zero. This indicated that the increases of TPC and TSC weights were not absolutely linear.

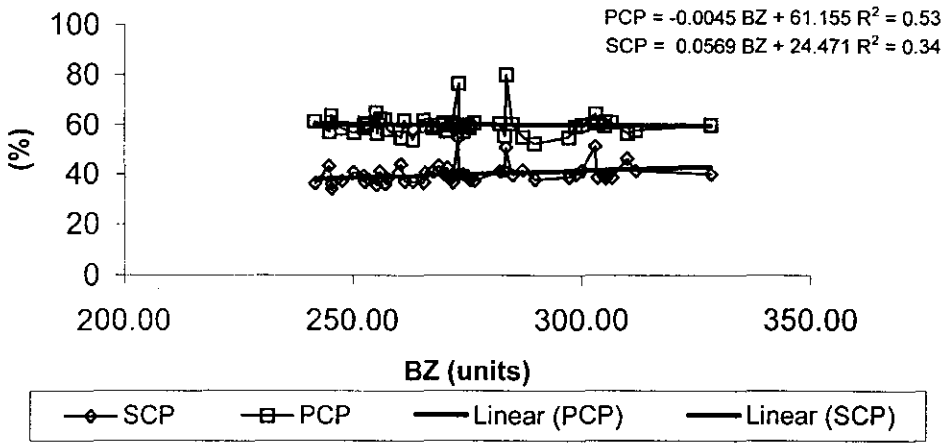

Figure 3. Regression of prime cuts (PCP) and secondary cuts (TSC) percentages on principal component of body size (BZ) of fattened Barki lambs

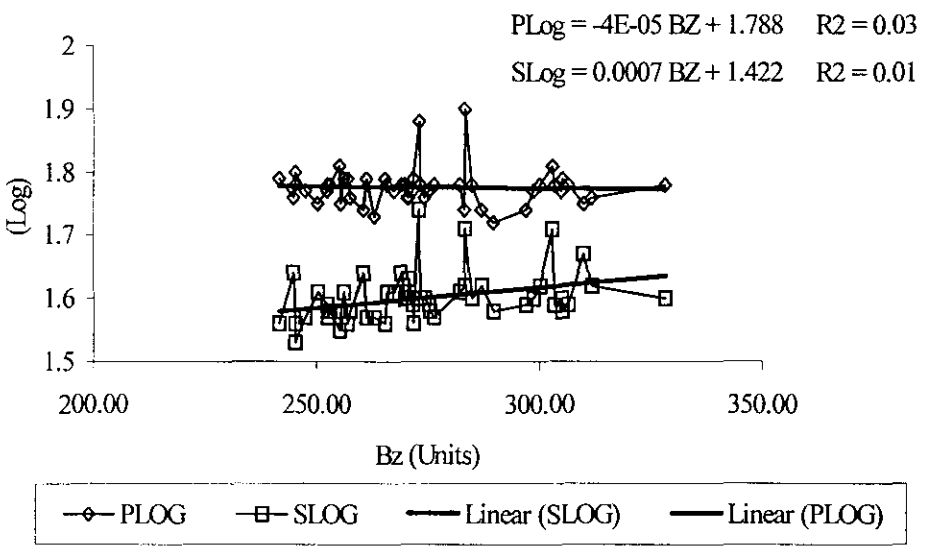

Figure 4. Regression of Log_{10} of prime cuts (LogP) and secondary cuts (LogS) on principal component of body size (BZ) of fattened Barki lambs

CONCLUSIONS

It could be concluded that, principal components technique could summarize the variation in body measurements into two principal components that accounted for 70% of variation in the dependency structure. The first principal component provided a measure of the general body size.

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التنبؤ ببعض مكونات الذبيحة فى الحملان البرقى المسمنة بإستخدام تقنية المكونات الأساسية

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أستخدمت تقنية المكونات الأساسية لبعض مقاييس الجسم للتنبؤ ببعض مكونات الذبيحة فى ذكور الحملان البرقى المسمنة. أجريت الدراسة خلال عام 1997 فى محطة تجارب برج العرب التي تتبع مركز البحوث الزراعية ، وزارة الزراعة و التي تبعد 40 كم غرب الإسكندرية، مصر. استخدم خمسون حمل ذكر برقى بمتوسط وزن 26 كج عند بدء التسمين. تم قياس ثمانية مقاييس خطية على الحيوان قبل الذبح. كانت صفات الذبيحة هى وزن الذبيحة (CWT) و إجمالي وزن القطعيات الممتازة (TPC) وإجمالي وزن القطعيات من الدرجة الثانية (TSC)، بالإضافة إلى نسبة إجمالي وزن القطعيات الممتازة (PCP) وإجمالي وزن القطعيات من الدرجة الثانية (SCP) إلى وزن الذبيحة. وتحوير بيانات إجمالي وزن القطعيات الممتازة وإجمالي وزن القطعيات من الدرجة الثانية باستخدام اللوغاريتم للأساس 10 (LogP) و (LogS). استخدمت تقنية المكونات الأساسية لتلخيص الاختلافات بين المقاييس إلى مقياس واحد سمي حجم الجسم (BZ). حسب حجم الجسم بتجميع حاصل ضرب عناصر أول مصفوفة أحادية للمكون الأول في كل مقياس. استخدمت الثمانية مقاييس لوجود ارتباط معنوي فيما بينهما ($p<0.05$) ولإن المكونين الأوليين يفسران 70% من الاختلافات بين المقاييس.

كان معامل الانحدار CWT, TPC, TSC, PCP, SCP, LogP, LogS هى 110 كج ، 0.6 كج ، 0.5 كج، -0.005 %، 0.06 % ، -0.0005 وحدة لوغاريتمه ، 0.0007 وحدة لوغاريتمه، على الترتيب. ويمكن استخلاص أن تقنيه المكونات الأساسية لخصت الاختلافات فى مقاييس الجسم فى مكونين مبدئيين يمثلان 70% من التباين الكلى. ولقد اعتبر المكون الأساسي الأول مقياس عام لحجم الجسم. تمثل الزيادة فى إجمالى القطعيات الممتازة والزيادة فى اجمالى قطعيات من الدرجة الثانية 55% (60 جم) ، 45% (50 جم) على الترتيب من الزيادة فى وزن الذبيحة (110 جم). كانت معاملات انحدار اجمالى القطعيات الممتازة واجمالى القطعيات من الدرجة الثانية بعد تحويل البيانات باستخدام اللوغاريتم للأساس 10 تقريبا صفر.