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 Log10 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 libitum* (G2).
3. Concentrate feed mixture 14% protein + barseem hay *ad libitum* (G3).
4. Barley grains + concentrate feed mixture 14% protein + molasses + *Acacia Saligna ad libitum* (G4).
5. Barley grains + concentrate feed mixture 14% protein + molasses + *Acacia Saligna* irrigated with untreated sewage water during cultivated period *ad libitum* (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 Log10 TPC and Log10 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 (PC1) of the observations study variables (X) is linear component. PC1 was used to calculate BZ by multiplying the elements of the first eigenvector times each body measurement as follows:

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

where,

- \(BZ_{ij}\) is body size, of jth animal, multiplied by ith element of 1st eigenvector;
- \(a_{i1}\) the 1st element of 1st eigenvector;
- \(a_{i2}\) the 2nd element of 1st eigenvector;
- \(a_{i3}\) the 3rd element of 1st eigenvector;
- \(a_{i4}\) the 4th element of 1st eigenvector;
- \(a_{i5}\) the 5th element of 1st eigenvector;
- \(a_{i6}\) the 6th element of 1st eigenvector;
- \(a_{i7}\) the 7th element of 1st eigenvector;
- \(a_{i8}\) the 8th element of 1st eigenvector; and
- \(BL_j, HG_j, HW_j, HS_j, TL_j, TU_j, TM_j, TT_j\) as 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 1st 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 1st 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

<table>
<thead>
<tr>
<th>Variables</th>
<th>BL</th>
<th>HG</th>
<th>HW</th>
<th>HS</th>
<th>TL</th>
<th>TU</th>
<th>TM</th>
<th>TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG</td>
<td>0.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW</td>
<td>0.50</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS</td>
<td>0.45</td>
<td>0.41</td>
<td>0.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL</td>
<td>0.41</td>
<td>0.52</td>
<td>0.50</td>
<td>0.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TU</td>
<td>0.43</td>
<td>0.70</td>
<td>0.35</td>
<td>0.41</td>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM</td>
<td>0.32</td>
<td>0.58</td>
<td>0.71</td>
<td>0.60</td>
<td>0.34</td>
<td>0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TT</td>
<td>0.32</td>
<td>0.50</td>
<td>0.53</td>
<td>0.36</td>
<td>0.57</td>
<td>0.53</td>
<td>0.50</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Items</th>
<th>Principal component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Variance (V)</td>
<td>3.95</td>
</tr>
<tr>
<td>V explained (%)</td>
<td>50</td>
</tr>
<tr>
<td>Accumulated (%)</td>
<td>50</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PC</th>
<th>BL</th>
<th>HG</th>
<th>HW</th>
<th>HS</th>
<th>TL</th>
<th>TU</th>
<th>TM</th>
<th>TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st PC</td>
<td>0.58</td>
<td>0.77</td>
<td>0.71</td>
<td>0.50</td>
<td>0.71</td>
<td>0.82</td>
<td>0.69</td>
<td>0.79</td>
</tr>
<tr>
<td>2nd PC</td>
<td>0.29</td>
<td>-0.30</td>
<td>0.56</td>
<td>0.76</td>
<td>0.08</td>
<td>-0.44</td>
<td>-0.60</td>
<td>0.01</td>
</tr>
</tbody>
</table>

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.
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.

CWT = 0.1097BZ - 12.725  \( R^2 = 0.53 \)

TPC = 0.0644BZ - 7.2975   \( R^2 = 0.18 \)

TSC = 0.0537BZ - 7.7338  \( R^2 = 0.18 \)

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.

CWT = 0.1097BZ - 12.725  \( R^2 = 0.53 \)

TPC = 0.0644BZ - 7.2975   \( R^2 = 0.18 \)

TSC = 0.0537BZ - 7.7338  \( R^2 = 0.18 \)

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 Log₁₀ 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.

REFERENCES


التبني ببعض مكونات الزيتية في الحملان البرقي المسممة باستخدام تقنية المكونات الأساسية

سهر محمد الشيخ، أحمد حسن همادي، مرتضى محمود مختار
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استخدمت تقنيات المكونات الأساسية لبعض مقاييس الجسم لتحديد بعض مكونات الزيتية في ذكور الحملان البرقي المسممة. أجريت الدراسة خلال عام 1997 في محطة تجارة برج العرب التي تتبع مركز البحوث الزراعية، وزارة الزراعة، والتي تتبع 40 كم غرب الإسكندرية، مصر. استخدم خمسون ذكر بريفي، متوسط وزن 26 كج. عند بدء التسمين تم قياس ثمانية مقاييس خطية على الحيوان قبل التسمين. كانت صفات جسم وإجمالي وزن القطعيات من (CWT) تشير إلى وزن الزيتية. تظهر أن توزيع ترتيبات جسم ووزن القطعيات من (SCP) تشير إلى وزن الزيتية. وتحوير بحثات جسم وإجمالي وزن القطعيات والوزن من الدرجة الثانية باستخدام اللوغاريتم للأساس 10 (LogS) و (LogP). استخدمت تقنيات المكونات الأساسية لتحديد اختلافات بين المقايس إلى ماياس واحد سمي حجم الجسم (BZ) حسب حجم الجسم.

وجملة حراس انوارن الأصفرية أحادية لتكون الأول في كل مقايس. استخدمت ثمانية مقاييس لوجود اختلاف معين فيما بينهما (p<0.05) ولا يوجد الاختلاف بين المقايس.

كان معدل الانحدار كان 0.6 كج ، 0.5 كج، LogS ,LogP ,SCP ,PCP TSC , TPC ,CWT

لكج، 0.5، 0.06 كج، 0.005 كج، 0.0005 كج، 0.00007 كج. وحجة لو غاريتمه، على الترتيب. ويمكن استخلاص أن تقنيات المكونات الأساسية لحصت الاختلافات في مقياس الجسم في مكونات محددة ضمن 70% من النبائي الكلي. وقد أظهر المكون الأساسي الأول مقايسات لحجم الجسم تمثل الزيادة في جميع القطعيات الممتازة والزيادة في جسم وإجمالي القطعيات من الدرجة الثانية (55% ) من الدرجة الثانية (60 جم، 45% ) من الدرجة الثانية (50 جم). وتمت معاملات اختلاس جسم وإجمالي القطعيات من الدرجة الثانية بعد تحويل البيانات باستخدام اللوغاريتم للأساس 10 تقريباً صفر.