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Allometric Growth Coefficients of Carcass Components and Carcass Waste in Awassi Lambs

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Abstract: This study aims to evaluate the developmental trends and the allometric growth values of carcass components and carcass waste in Awassi lambs. Twenty five entire Awassi lambs were seriously slaughtered at 20, 25, 30, 35 and 40 kg. Results revealed that the allometric growth coefficients of dissectible lean (0.853) and bone (0.793) weights were negative heterogonic ($b<1$) indicating that these tissues significantly ($p<0.01$) grew at slower rate than carcass weight. Conversely, fat was positive heterogonic (1.859) and considered a late maturing tissue. Also, it seems from the coefficients that leg is an early maturing ($b=0.938$), whereas shoulder is a late maturing ($b=1.293$). Rack, neck, breast and flank are isogonic ($b=1$) and grew at a similar rate in relation to carcass weight. Carcass fat, carcass waste fat and fat tail relative to empty body weight are 1.920, 0.089 and 1.036, respectively, indicating carcass fat and fat tail are positive heterogonic demonstrating that are high impetus and grow at a higher rate than empty body weight, whereas carcass waste fat had allometric coefficient <1, low impetus and early maturing tissue. Skin, testes, spleen and kidney exhibited isogonic growth indicating that these components are grow similar rate to empty body weight. On the other hand, head, feet, liver, lung, heart and empty digestive tract are early maturing organs than did empty body weight.

Keywords: Allometric growth, Awassi, Carcass composition, Fat depots.

Introduction

In the Mediterranean's east, the Awassi sheep is the most widespread breed. In Iraq and Syria, it is the most common breed, as well as Jordan and Palestine consider only native breed. Also, it makes a significant contribution to Turkish sheep breeds. Moreover, the breed has expanded to Australia and South America from the place of origin in South West Asia (Galal *et al*., 2008). The production of meat is based mainly on growth and development of animal, while tissue distribution of the carcass is an important in determining carcass quality. The main edible tissues in the carcasses are lean and a lesser extent fat. (Mahgoub & Lodge, 1994). Therefore, in order to meet the demand for sheep production, one of the strategies is to produce lambs with a high proportion of lean and acceptable fat cover, resulting in a high proportion of first category cuts. (Souza *et al*., 2013).

Both nutrition studies and production system are important in an attempt to maximize profit, through knowledge carcass components, quantitative of each carcass tissues, and variations in growth patterns at various phases of growth. Therefore, efficient marketing of meat is important for animals as a meat producer, through knowledge carcass components and their tissues distribution lean, fat and bone (Negussie *et al*., 2004).

Many studies concerning the evaluation of carcass and their composition, have received a lot of attention in different regions of the world, particularly in developed nations, where these breeds are used primarily for meat production. However, there is no information on tissue partitioning in Awassi sheep, it is necessary to define tissue partitioning and carcass composition in this breed in all stages of growth in order to identify their body development phase where strategic intervention would be beneficial.

The main aim of this work was to determine the growth pattern and body composition of Awassi lambs at various stages of development.

Materials & Methods

The current work was carried out at University of Duhok, College of Agricultural Engineering Science, where 25 weaned entire Awassi lambs (4-month age and 19.00 ± 0.12kg body weight). Lambs were randomly and equally and individually penned (1×2 m) into five treatment groups to be slaughtered at 20, 25, 30, 35 and 40 kg. After an adaptation period for 10 days, lambs were fed concentrate diet ad lib containing $151.1 g.kg^{-2}$ DM crude protein and $12.24 MJ.kg^{-1}$ DM as metabolizable energy.

Slaughtering of animals

When lamb had reached target weight, they were slaughtered. After removing the skin, head, fore and hind feet, and visceral, the dressed carcass was comprised of the body. Hot carcass weight and weight of all non- edible and edible offals were recorded. The full gastrointestinal tract was weighed, and then emptied, washed and re-weighed to calculate empty body weight. Also, fats of cardiac, omental and mesenteric, were weighed individually.

Carcass traits and physical dissection

Cold carcasses were weighed after being chilled at 4°C for 24 hours, and renal and pelvic fat were weighed separately. The carcass was divided into two halves along the spinal cord, with the right half being chopped into eight whole-sale cuts. Each whole sale cuts were completely dissected into lean, fat, and bone in order to determine their percentages. Carcass fat includes subcutaneous and intermuscular fat, whereas non-carcass fat includes omental, mesenteric, pelvic, renal, and cardiac fat.

Statistical analysis

For utilizing and analyzing the growth of different body tissues in proportion to carcass side and empty body weight, the allometric growth equation y= a xb was applied (Huxley, 1932), using slaughter and carcass data after changed to logarithms base 10, where:

y= body component weight.

x = empty body weight or carcass side weight.

a = y value when x = 1

b = growth coefficient of dissectible body components relating to carcass weight or empty body weight.

The t- test was used to verify b value, when b=1, indicating that growth of both x and y were similar (isogonic) during the growth period. While, when b≠1, growth of both x and y were different (heterogonic), being negative if b<1 and positive if b>1. The regression procedure of the SAS (2012) was used to obtain the allometric coefficients.

Results & Discussion

Carcass composition

The dissectible lean, fat and bone as a weight from the right side of cold carcass was increased linearly (p≤0.01) with increasing slaughter weight (Table 1). Such of these effects was already reported (Al- Owaimer *et al*., 2013; Carvalho *et al*., 2016). With increasing slaughter weight, the proportion of dissectible lean and bone as a percentage of the cold carcass side decreased quadraticly (p≤0.01), whereas the percentage of fat was increased quadratically (p≤0.01).The allometric growth coefficients of dissectible lean (0.853) and bone (0.793) weights were negative heterogonic (b<1), indicating low impetus and early maturing tissue, and these components significantly (p≤0.01) grew at a slower rate than carcass weight (bone has earlier growth than lean). While allometric value of dissectible fat weight was 1.859, it means positive heterogonic growth, demonstrating a high impetus and late maturing tissue. The results agree with that it is reported by Al-Jassim (1995), Teixeira *et al*. (1995), and Negussie *et al*. (2004).

Table (1): Lean, fat and bone as weight and percentage to carcass side weight.

Components	Lambs slaughtered at					Coefficients	
	20 kg	25 kg	30 kg	35 kg	40 kg	b	R^2
Right carcass g	4239^{d}	4670^{d}	5665^{c}	7131^{b}	8299^{a}	--	--
Lean g	2667^{d}	2958^{d}	3546^{c}	4157^{b}	4770^{a}	0.853 **	0.96
Fat g	519^{d}	558^{d}	874^{c}	1279^{b}	1790^{a}	1.859 **	0.89
Bone g	1053^{c}	1154^{bc}	1245^{b}	1695^{a}	1739^{a}	0.793 **	0.88
Lean %	62.93^{a}	63.33^{a}	62.63^{a}	58.19^{b}	57.37^{b}	-0.146 **	0.41
Fat %	12.21^{c}	11.93^{c}	15.46^{bc}	17.92^{b}	21.68^{a}	0.859 **	0.64
Bone %	24.85^{a}	24.73^{a}	21.90^{bc}	23.88^{ab}	20.94^{c}	-0.206 **	0.33

** (P≤0.01), NS: R^2: Determination coefficient, b: Regression coefficient.

Whole sale cuts

The differences observed in the mean proportions of the whole sale cuts expressed as a weight of cold carcass side weight (Table 2) at different slaughter weight were statistically significant ($p<0.01$).

The leg proved to be an early cut, negative heterogonic growth with allometric coefficient less than one ($p\leq0.01$), indicating low impetus and early maturing cut. Similar results have been reported earlier in sheep (Al- Jassim, 1995; Al- Owaimer *et al*., 2013; Santos *et al*., 2020) and goats (Teixeira *et al*., 1995; Bonvillani *et al*., 2010). Moreover, Thonney *et al*. (1987) classified leg joint as early maturing of many breeds when animals slaughtered at 0.40 to 0.70 of mature body weight. However, this rate of growth differed in Saanen goats as indicated by Yanez *et al*. (2009), who found that the leg coefficient equal to one which might be due to the dairy breed used in his study. Such differences could be attributable to the production system used, which is in charge of optimizing the genotypes' productive properties. Shoulder had an allometric coefficient more than one (1.293) and behaves as a positive heterogonic growth, indicating high impetus and late maturing development which leads to grew at a rate higher than the rate of growth of carcass weight. These results agreed with findings of Santos *et al*. (2020) in lambs slaughtered at 3 mm subcutaneous fat thickness and by Al- Owaimer *et al*. (2013). On the other hand, this result differs in goats by Yanez *et al*. (2009), who found that the growth is isogonic and equal to one. These differences might be attributed to the breed itself, that have poor anterior conformation especially fat tissue in the beginning that allow the cuts to follow the growth of more fat deposition, as shown by Carvalho *et al*. (2016) in Texel lambs who found that (b) values were <1 in meat (0.893) and bone (0.540) while fat (1.676) is greater than one in shoulder cut.

The growth coefficient of rack, neck, breast and flank are isogonic with (b=1) and their values were 1.099, 1.058, 1.188 and 1.051 respectively, therefore, the growth of these components grew at a similar rate in relation to carcass side weight. The isogonic growth of these components might be attributed to the low dissectible fat deposition that allowed the cuts to follow the same rate of growth. These results agreed with that demonstrated earlier by Yanez *et al*. (2009) who found isogonic growth for all cuts in Saanen goats. Similarly, Al- Owaimer *et al*. (2013) indicated a slight difference in the relative growth of these cuts weights with the exception of flank which showed a positive heterogonic, greater than one because flank is considered a region with late maturation, due to higher fat deposition and lower lean compared to other cuts.

Allometric coefficient of loin (0.755) and foreshank (0.422) had (b) values significantly <1, indicating low impetus and these parts grew at slower rate than the whole, which means are early maturing tissue. Similarly, Santos *et al*. (2020) in Dorper× Santa Ines, found that this cut was early maturing and their (b) value was less than one. The growth rate obtained for these two cuts in the present study is differing from Al- Jassim (1995) in Arabi sheep and Al- Owaimer *et al*. (2013) in Ardhi goat, who indicated allometric coefficient greater than one. Such results could be attributed to the low dissectible fat deposition in these cuts.

Table (2): Cuts as weight and percentage to carcass side weight.

Components	Lambs slaughtered at					Coefficients	
	20 kg	25 kg	30 kg	35 kg	40 kg	B	R^2
Right carcass g	4249[d]	4670[d]	5665[c]	7131[b]	8299[a]	--	--
Leg g	1510[d]	1600[d]	1970[c]	2439 [b]	2979[a]	0.938 **	0.98
Shoulder g	721[e]	913[d]	1108[c]	1495 [b]	1742[a]	1.293 **	0.91
Loin g	371[d]	424[cd]	495[bc]	555[ab]	622[a]	0.755 **	0.72
Rack g	333[e]	428[d]	509[c]	630[b]	733[a]	1.099 **	0.90
Breast g	365[c]	362[c]	507[b]	643[b]	811[a]	1.188 **	0.76
Neck g	278[b]	292[b]	298[b]	490[a]	532[a]	1.058 **	0.68
Fore shank g	420[bc]	381[c]	417[bc]	530[a]	484[ab]	0.422 **	0.34
Flank g	241[c]	270[bc]	361[b]	349[b]	578[a]	1.051 **	0.71
Leg %	35.67[a]	34.26[ab]	34.79[ab]	34.17[ab]	33.67[b]	-0.061 *	0.19
Shoulder %	16.90[b]	19.58[ab]	19.53[ab]	20.97[a]	20.95[a]	0.293 **	0.33
Loin %	8.76[ab]	9.06[a]	8.70[ab]	7.79[ab]	7.48[b]	-0.244 *	0.21
Rack %	7.85[b]	9.16[a]	8.98[a]	8.79[ab]	8.84[ab]	0.099 ns	0.07
Breast %	8.62[ns]	7.75[ns]	8.90[ns]	9.10[ns]	9.82[ns]	0.188 ns	0.07
Neck %	6.56 [ab]	6.23[ab]	5.28[b]	6.84[a]	6.41	0.058 ns	0.02
Fore shank %	9.92[a]	8.15[b]	7.36[bc]	7.42[bc]	5.82[c]	-0.577 **	0.49
Flank %	5.69[ab]	5.77[ab]	6.44[a]	4.89[b]	6.98[a]	0.051 ns	0.01

* ($P \leq 0.05$), ** ($P \leq 0.01$), ns: Non-Significant. R^2: Determination Coefficient. #b: Regression Coefficient.

Partitioning of fat

In relation to empty body weight with the exception of total non- carcass fat, lambs that slaughtered at 40 kg had significantly ($p \leq 0.01$) higher percentages of carcass fat and fat tail (Table 3). Also, it appears that omental and kidney fat increased ($p<0.05$) with increase slaughter weight while, mesenteric and heart fat decreased ($p<0.01$) with increasing slaughter weight. However, based on total body fat, lambs that slaughtered at 20 kg had significantly lower ($p>0.01$) carcass fat, fat tail and higher ($p>0.01$) total non- carcass fat. At the time when the lambs reached 40 kg they had higher carcass fat, fat tail and lower total non- carcass fat (omental, mesenteric, kidney and heart fat).

The allometric coefficients of the three major classes of fat depots, carcass fat, non-carcass fat and fat tail relative to empty body weight, are of 1.920, 0.089 and 1.036 respectively, indicating that carcass fat and fat tail had positive heterogonic growth ($p<0.01$) with ($b>1$), hence high impetus and grew at a higher rate than growth of the empty body weight, while non- carcass fat had negative heterogonic growth ($p<0.01$) with ($b<1$), hence low impetus and grew at a slower rate than growth of the empty body weight, with respect to the three classes of fat depots, the results showed that the highest (b) value was obtained in carcass fat, indicating that it is the latest developing depots, followed by tail fat and total non- carcass fat. Similar results were obtained by Mahgoub & Ledge (1994) and Mtenga *et al*. (2005) found that allometric coefficient for fat depot growth relative to empty body weight was more than one in carcass fat and fat tail, indicating that when empty body weight grew, the proportions of these depots increased. Similar trend in the non-carcass fat depots were observed in the coefficients of both omental, mesenteric and heart fats, they are negative heterogonic growth and early growing depots as compared to the kidney fats, that's positive heterogonic growth with ($b>1$).

Regarding to the growth coefficients of fat depots relative to total body fat, results showed that the carcass fat grew isogonically, it means grew similar rate to the total body fat. However, total non- carcass fat (0.392) and fat tail (0.130), presented negative heterogonic growth with b value less than one, indicating low impetus and early mature, the growth rate was slower than the growth rate of the total body fat. On the other hand, the growth coefficient of individual fat depots for omental, mesenteric, kidney and heart fat are 0.329, 0.619, 0.140 and 0.860 respectively, which exhibited negative heterogonic growth significantly (p≤0.01), low impetus and early maturing tissue. The results obtained in this study relative to total body fat was confirmed by Negussie *et al*. (2000) who found that allometric equation of carcass fat, non- carcass fat and tail fat were 0.997, 0.856 and 1.270 respectively in Menz sheep.

Table (3): Fats as a percentage of empty body weight and total body fat.

Components	Lambs slaughtered at					Coefficients	
	20 kg	25 kg	30 kg	35 kg	40 kg	b	R^2
EBW g	17870[e]	21357[d]	26119[c]	30890[b]	35518[a]	--	--
Omental %	0.838[b]	0.828[b]	0.846[b]	0.888[ab]	0.974[a]	0.240 **	0.22
Mesenteric %	0.994[a]	0.908[b]	0.812[cd]	0.870[bc]	0.774[d]	-0.309 **	0.61
Kidney %	0.400[c]	0.474[c]	0.636[b]	0.772[a]	0.710[ab]	1.020 **	0.68
Heart %	0.378[a]	0.338[ab]	0.280[bc]	0.256[c]	0.242[c]	-0.683 **	0.53
Total non-carcass fat %	2.60[ab]	2.55[b]	2.57[b]	2.78[a]	2.70[ab]	0.089 *	0.14
Total carcass fat %	2.90[c]	2.61[c]	3.34[c]	4.13[b]	5.03[a]	1.920 **	0.64
Fat tail %	3.98[d]	5.54[c]	6.45[bc]	8.22[a]	7.55[ab]	1.036 **	0.72
Total body fat %	9.49[c]	10.69[bc]	12.37[b]	15.14[a]	15.28[a]	0.748 **	0.81
Total body fat g	1697[d]	2284[d]	3233[c]	4682[b]	5436[a]	--	--
Omental %	8.84[a]	7.79[ab]	6.83[bc]	5.91[c]	6.41[c]	-0.329 **	0.68
Mesenteric %	10.61[a]	8.54[b]	6.56[c]	5.79[cd]	5.13[d]	-0.619**	0.94
Kidney fat %	4.13[b]	4.42[ab]	5.14[a]	5.12[a]	4.64[ab]	0.140 *	0.18
Heart fat %	3.99[a]	3.18[a]	2.28[b]	1.71[b]	1.64[b]	-0.860 **	0.84
Total non- carcass fat %	27.58[a]	23.94[b]	20.82[c]	18.54[c]	17.84[c]	-0.392 **	0.89
Total carcass fat %	30.21[ab]	24.38[c]	27.04[bc]	27.34[bc]	33.03[a]	0.095 ns	0.07
Fat tail %	42.19[b]	51.67[a]	52.13[a]	54.10[a]	49.12[a]	0.130 **	0.27

* (P≤0.05), ** (P≤0.01), ns: Non-significant. R^2: Determination coefficient. #b: Regression coefficient.

Offals

As the lamb grew from 20 to 40 kg (Table 4), the weight of empty body weight and their relative hot carcass increased significantly (p≤0.01) with increasing slaughter weight. Hot carcass had significantly negative growth coefficient (b<1), were low impetus. These results are in the line with that reported by Al-Jassim (1995), and Bonvillani *et al*. (2010), who reported that hot carcass had allometric coefficient greater than one.

The allometric coefficient of head was significantly less than one (0.240), indicating a negative heterogonic growth, with low impetus, which grows slower than the empty body weight. The early growth of this component agrees with results obtained by Kirton *et al*. (1972), Mahgoub & Ledge (1994), Al-Jassim & Al-Saigh (1999) and Garcia *et al*. (2014). Feet, also had a negative heterogonic growth with a significant allometric coefficient less than one. Thus, for Awassi lambs, this component had low impetus, grows slower than the lambs empty body weight. The early maturing of feet agrees with results obtained in sheep by Mahgoub & Ledge (1994), Al-Jassim & Al-Saigh (1999) and Garcia *et al*. (2014), and in goat by McGregore (1992) who indicating low impetus and early maturing components. Skin demonstrated isogonic growth, similar to the empty body weight rate. The results are in accordance with those found in sheep by Mahgoub & Ledge (1994) and in goat by McGregore (1992) who indicating the relative growth coefficient was equal to one.

The testes grow isogonically, which indicate that the rate of growth was similar to the empty body weight. The growth rate obtained for this organ in the current study is differed from Al- Jassim & Al- Saigh (1999) in Arabi sheep and Garcia *et al*. (2014) in crossbred lambs, who found that b value was greater than one. Such difference could be mainly due to the genetic make –up of breeds, as well as management systems, nutrients and environmental condition especially temperature being exposed on these animals (Hermiz & Alkass, 2019).

The growth rate of spleen was isogonic, and their growth was same to empty body weight. Similarly, Garcia *et al*. (2014) in four breeds of sheep found that spleen had isogonic growth and their rate was similar to empty body weight.

Organs such as liver, lung and heart, exhibited a negative heterogonic growth with allometric coefficient values significantly less than one (0.369, 0.368 and 0.219 respectively), hence these organs are low impetus and early maturing components that’s grew lower than the empty body weight. These results were confirmed by Kirton *et al*. (1972) and Al- Jassim & Al- Saigh (1999), and Garcia *et al*. (2014) indicating that these organs were developed rapidly.

Kidney was grown isogonically, with same rate of empty body weight. Similarly, Garcia *et al*. (2014) in Santa×Bergamasca showed that (b=1) for the kidney. However, in the other breeds (Kirton *et al*., 1972; Al- Jassim & Al- Saigh, 1999) found that the rate of growth was faster than empty body weight. Such difference may be due to the organ growth rate which was differing between genotype.

Empty digestive tract showed (b) value less than one, negative heterogonic growth with b value 0.547, the rate of development tract was slower than empty body, demonstrating low impetus, and the early growth of tract was due to the breaking of ingested food, absorbing nutrients, and supplying the lamb's growth requirement. These results disagree with Al- Jassim & Al- Saigh (1999) who found that empty alimentary canal has growth coefficient value significantly greater than one. Such as this difference in coefficient value might be due to the type of ration which lambs were fed.

Table (4): Offals as a percentage of empty body weight (EBW)

Components	Lambs slaughtered at					Coefficients	
	20 kg	25 kg	30 kg	35 kg	40 kg	b	R^2
EBW g	17870^{e}	21357^{d}	26119^{c}	30890^{b}	35518^{a}	--	--
Hot carcass %	54.58^{ab}	52.40^{b}	53.12^{b}	56.75^{a}	57.04^{a}	0.096 **	0.26
Head %	7.52^{a}	7.22^{ab}	6.59^{c}	6.96^{b}	6.21^{d}	-0.240 **	0.65
Skin %	15.32	16.14	16.58	16.79	15.76	0.064 ns	0.06
Feet %	3.61^{a}	3.15^{b}	2.86^{b}	2.85^{b}	2.25^{c}	-0.598 **	0.70
Testes %	0.562^{bc}	0.632^{b}	0.574^{bc}	0.452^{c}	0.856^{a}	-0.257 ns	0.06
Spleen %	0.280^{a}	0.274^{a}	0.206^{b}	0.234^{ab}	0.246^{ab}	-0.240 ns	0.10
Liver %	2.41^{ab}	2.46^{a}	2.40^{ab}	2.09^{bc}	1.87^{c}	-0.369 **	0.41
Lung %	2.08^{a}	1.92^{a}	1.46^{b}	1.99^{a}	1.51^{b}	-0.368 *	0.13
Heart %	0.494^{a}	0.456^{ab}	0.444^{ab}	0.454^{ab}	0.410^{b}	-0.219 **	0.30
Kidney %	0.366^{b}	0.420^{a}	0.310^{c}	0.354^{b}	0.354^{b}	-0.155 ns	0.10
Empty DT %	9.16^{a}	9.44^{a}	8.05^{b}	6.73^{c}	6.73^{c}	-0.547 **	0.78

* ($P \leq 0.05$), ** ($P \leq 0.01$), NS: Non-Significant. R^2: Determination Coefficient. #b: Regression Coefficient.

Conclusion

Based on presented results, it can be concluded that muscle and bone show early growth, whereas the fat has late growth. Among different cuts, leg and shoulder showed early and late growth which is relative to carcass weight. While carcass fat and fat tail grew at higher rate than empty body weight growth, non- carcass fat, on the other hand, grew at slower rate than empty body weight.

Contributions of authors

C. A.M. Y.: Collection data and writing.

J. E. A.: Reading and revising.

K. N.M.: Reading.

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Conflict of interest

The authors have no possible conflict of interest.

Ethical approval

All ethical guidelines related to poultry breeding and care issued by national and international organizations were implemented in this report.

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قياس معامل نمو مكونات الذبيحة ومخلفاتها في الحملان العواسية

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تهدف هذه الدراسة الى تقويم نمط التطور وقيم معامل النمو لمكونات الذبيحة ومخلفاتها في الحملان العواسية. تم ذبح 25 حملا عواسيا بصورة متعاقبة عند اوزان 20و 25و 30و 35و 40 كغم. تشير النتائج بأن معامل النمو لكل من اوزان العضلات (0,853) و العظام (0,793) هي سالبة و غير متماثلة (b<1) وتعني بأن هذه الانسجة نموها ابطأ معنويا (p<0.01) من وزن الذبيحة, بينما الدهن كان موجب و غير متماثل (1,859) و يعد من الانسجة المتأخرة النضج. وكما يتضح من النتائج بأن معامل النمو للفخذ مبكر النضج (b=0.938) في حين يعد الكتف متأخر النضج (b=1.293) ولوحظ بأن قطعيات الصدر و الرقبة والاضلاع و الخاصرة متماثلة (b=1) و تنمو بمعدلات متساوية لوزن الذبيحة. بلغ معدل النمو لكل من دهن الذبيحة ودهن مخلفات الذبيحة و دهن الالية 1,920و 0,089 و 1,036 على التوالي, وهذا يعني بأن دهن الذبيحة و الالية غير متماثل و موجب و ينمو بمعدل اعلى من وزن الجسم الفارغ , في حين أن معامل النمو لدهن مخلفات الذبيحة هو < 1 ويعد مبكر النضج. كما تبين بأن الجلد و الخصيتين و الطحال والكليتين هي متماثلة النمو و تشير بأن هذه المكونات تنمو بصورة متشابهة لوزن الجسم الفارغ، في حين يعد كل من الراس و الاقدام و الكبد و الرئتين و القلب و الجهاز الهضمي الفارغ مبكر النضج مقارنة بوزن الجسم الفارغ.

الكلمات المفتاحية: معامل النمو،عواسي، تركيب الذبيحة، ترسيب الدهون.