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ScienceDirect
Small Ruminant Research 66 (2006) 222–229
Small Ruminant Research
www.elsevier.com/locate/smallrumres

Growth curves for body weight and carcass components, and carcass composition of the Karagouniko sheep, from birth to 720 d of age

M. Goliomytis *, S. Orfanos, E. Panopoulou, E. Rogdakis

Department of Animal Breeding and Husbandry, Agricultural University of Athens, 75 Iera Odos, 11855 Athens, Greece

Received 21 October 2004; received in revised form 9 September 2005; accepted 9 September 2005
Available online 18 November 2005

Abstract

The growth and development of body weight (BW), carcass components and carcass composition of 102 male and female sheep of the Karagouniko dairy breed, from birth to 720 d of age, were studied. Growth curves, using the Richards growth function, were calculated for BW and carcass components. The type of the curves estimated was typically sigmoid. Asymptotic weight for BW was estimated at 101.3 and 76.5 kg for males and females, respectively. Age at point of inflection, at which maximal growth rate was attained, was predicted at 227 and 244 d, for male and female body weight curves, respectively. Among body constituents, the earliest age at the inflection point was predicted for the weight of bones (110.4 d) and the latest for total fat weight (246.9 d). No, significant, sex differences were detected for any of the estimates for maturation index *k*. At carcass weights of 15 kg, males were leaner and accumulated proportionately less fat than females. There was no effect of sex on bone percentage. Comparisons with carcass studies on meat-type breeds of sheep were discussed. The present study provides detailed information on growth potential and carcass development, of the Karagouniko sheep, by means of a mathematical model.

Keywords: Karagouniko dairy sheep; Growth; Carcass composition; Growth curves

1. Introduction

Sheep breeds in Greece are all of the dairy type and sheep are kept mainly for milk production. Meat production is derived from lambs slaughtered soon after weaning at about 30–50 d of age. The Karagouniko dairy sheep breed is the most numerous in Greece (Rogdakis, 2002). It is originated in the region of Thessalia, in central Greece, and because of its fitness and high milk and meat production performance, it is spread almost all over the Greek mainland. This breed has been widely studied for its milk production and reproductive traits, but few studies on meat production are reported. Panopoulou et al. (1989) and Papadimitriou et al. (1989) studied carcass composition at 30 kg live weight. Zygoyiannis et al. (1990) investigated growth and carcass composition over a range of commercial live weights from 16 to 44 kg. The only study reporting on growth and carcass composition from weaning to live weight nearing maturity at 36 wk of age and with application of a mathematical growth model to live body weight (BW) is that of Zygoyiannis et al. (1997). Growth curve functions are the most sufficient means for describing growth of live BW and its components because they summarize valuable information into few parameters, which have biological meaning. Growth functions available for describing growth potential are the three-parameter models (Brody's, von Bertalanfy, logistic, Gompertz) and the

* Corresponding author. Tel.: +30 2105294431; fax: +30 2105294442.
E-mail address: mgolio@in.gr (M. Goliomytis).

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doi:10.1016/j.smallrumres.2005.09.021

four-parameter model (Richards), which summarizes the most important growth functions into one with a flexible point of inflection (Fitzhugh, 1976; France and Thornley, 1984).

The aim of the present study was to investigate the growth potential and carcass characteristics of the Karagouniko sheep from birth to maturity at 720 d of age by means of a mathematical model. Growth curves for BW, carcass weight, visceral organs and carcass joints and constituents, i.e., muscle, fat and bone were calculated. Body composition was predicted in the extended growth period and comparisons with studies concerning meat-type breeds were made.

2. Materials and methods

2.1. Animals

One hundred and two lambs, 51 of each sex, were reared indoors from birth to 720 d of age. The lambs were randomly selected from 10 commercial flocks from central Greece (Thessalia) and within the framework of performance scheme of the Karagouniko sheep. The lambs were transported to the experimental station of the Agricultural University of Athens directly after weaning at 42 d of age. Weight and slaughter data, at birth were obtained from three males and three females from the Karagouniko sheep flock kept at the Department of Animal Breeding and Husbandry farm. Feed was supplied twice daily and water for ad libidum consumption. All lambs were offered a pelleted mixture consisting of alfalfa, barley, soy bean meal, salt, vitamins and trace elements. The composition of the diet changed at 98, 242, 354 and 494 d of age. The five diets used contained 12.2, 11.9, 11.2, 10.5 and 9.8 MJ/kg DM metabolizable energy, 193, 151, 173, 180 and 188 g digestible crude protein (CP)/kg DM and 102, 142, 187, 219 and 243 g crude fibre/kg DM, respectively.

2.2. Body weight and carcass measurements

At 45 d intervals, six lambs, three from each sex, were randomly selected and live BW was recorded. Then the animals were slaughtered and weight of carcass and non-carcass components were recorded. The lambs were fasted for 24 h prior to slaughter. Each carcass included tail and kidneys. Dressed carcasses were then chilled to 4 °C until the following morning when dissection took place. Tail, kidneys, perirenal and retro-peritoneal (KKCF) fat were removed from each carcass, which was then divided into left and right side. Subsequently, the right carcass side was separated into six anatomically defined cuts as follows: neck, shoulder, thorax (the whole ribs with associated vertebras), loin, flank and leg. The carcass joints where then dissected into muscle, fat and bone. Total carcass muscle, fat and bone were calculated from the sum of the dissected joints of the right half after multiplying by 2.

2.3. Statistical analysis

Richards function (Richards, 1959) was chosen to fit the data for live BW and weight of the major carcass components, as it summarizes the most important growth functions into one. Richards function for the present study was in the following form:

$$W_t = A\,[1 \pm b\exp(-kt)]^{-1/n},$$
$$\text{for } n > -1,\ n \neq 0,\ A, k > 0$$

$$\text{If } n < 0, \quad W_t = A[1 - b\exp(-kt)]^{-1/n}$$

$$\text{If } n > 0, \quad W_t = A[1 + b\exp(-kt)]^{-1/n}$$

The biological interpretation of the parameters in the model is as follows—W_t: weight of body or carcass component at age t; A: upper asymptotic weight as age approaches infinity (an estimation of mature weight); k: rate of maturing, refers to growth rate relative to mature weight and measures the relative rate at which asymptotic value is attained; n: shape parameter determining the position of the inflection point at which the auto acceleration growth phase passes into the auto retardation phase, and the growth rate is maximum; b: integration constant. Absolute growth rate was estimated by the first derivative of the Richards function. The age (t_i), weight (W_i), absolute growth rate (AGR_i) at the inflection point and mean absolute growth rate (mAGR) were calculated as follows:

$$t_i = -\frac{1}{k}\left(\ln\frac{n}{b}\right), \qquad W_i = A(n+1)^{-1/n},$$

$$AGR_i = kW_i(n+1)^{-1}, \qquad mAGR = Ak[2(n+2)]^{-1}$$

The data were analyzed with the analysis of variance (ANOVA) procedure of SAS software (SAS Institute, 1990). The non-linear regression procedure (NLIN) with the Marquardt algorithm was used to fit the Richards function to the observed data. Significance of sex differences, for estimated means of A and k, and differences between carcass constituents, within sexes, for k, were examined by a t-test.