J. Agric. Sci. Mansoura Univ., 27 (2): 881 - 887, 2002

PREDICTION OF ABDOMINAL FAT PAD IN BROILER CHICKS USING SOME BLOOD MEASUREMENTS.

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ABSTRACT

Predicting of abdominal fatness were examined using 120 Arbor Acres chicks indirect measurements used were information on body weights and some blood constituents (concentrations of plasma triglyceride and cholesterol). The direct measurements included abdominal fat weight (AFW) and abdominal fat weight as percentage of marketing body weight (AFP). The AFW and AFP were highly correlated with triglyceride (r = 0.78 and 0.81, resp.) cholesterol (r = 0.62 and –0.64., resp.) Adjusting the data to fixed marketing body weight reduced the corrlations of AFW and AFP with body weight and daily gain to negligible values and slightly increased the correlations with triglyceride. The inclusion of triglyceride and cholesterol into one equation was not useful in increasing the accuracy of prediction (R2= 0.588 VS. 0.551) Adjusting the data to fixed body weight end point improved the efficiency of triglyceride in predicting AFW by 28%. It could be concluded that the plasma triglyceride (PTG) content (mg/dl) could be used as a reasonably accurate predictor of abdominal fatness using these equations:

AFW (g) = 6.53 + 1.22 PTG (R2=0.551).

AFP % = 0.486 + 0.116 PTG (R2=0.46).

Keywords: Abdominal fatness, prediction equation, broiler chickens, blood parameters.

INTRODUCTION

Recent strains of domestic birds selected for rapid growth exhibit excessive body fat deposition.

In broilers, early fast growth rate is accompanied by a number of problems-namely, increased carcass fat content, a high incidence of metabolic diseases and high mortality.

Much effort has been directed at manipulating the fat composition of poultry meat due to consumers demand for low fat and low cholesterol foods. This consideration is important because results of many human studies have related high dietary fat intake to the incidence of cardiovascular diseases and cancer (Mirosh and Becker, 1984). Decreased abdominal fat would constitute, however, an important advantage in broilar production because this fat is a waste product to the poultry processor waste managementand product yeild, (Heath, *et al.*, 1980 and Santoso *et al.*, 1995), to the producer, high feeding cost (Griffith, *et al.*, 1978), to meat trader poor carcass yield (Patterson and Fairs, 1984), to the consumer over fatness yield, (Griffith, *et al.*, 1978) and to the breeder difficult to assess in live birds.

According to Leenstra *et al.*(1986) the total amount of body fat is variable and can reach 150-200 g/kg body weight. A minimum of 9 g fat/kg

body weight is required for normal body functioning 20-25 g/kg is present in tissues as physiologically necessary fat. The remainder, i.e, over 85% of total body fat is stored in adipose tissue. Dietary manipulation of total body fatness received also considerable attention, the high energy diets enhance fat deposition in broiler.

One of the main problems associated with selection against abdominal fat, in order to obtain genetically lean lines of chickens arises from the need to slaughter birds to measure abdominal fat methods for assessing fatness in live birds by a cloacal caliper method (Pym and Thomson, 1980); keel and breast length, computerized X-ray topography.

Plasma triglyceride (PTG) concenteration as blood fat-linked parameter. It is well known that over 70% of lipid synthesis in chickens, unlike mammals occurs in the liver and only about 5% in adipose tissue. Lipid stored in adipose tissue is synthesized from other nutrient. Highly significant phenotypic correlation (0.70 males; 0.65 females) were reported between plasma PTG concentration and carcass fat (Griffin and Whitehead, 1982, Leclercq, 1988 and Geraert, *et al.*, 1996).

The objective of the present work was to determine whether carcass fatness of market age broilers could be predicted by one or a combination of the following measurements, body weight, plasma cholesterol level and plasma triglyceride concentration.

MATERIALS AND METHODS

Experimental birds: A total of 120 one day-old unsexed Arbor Acres chicks were obtained from a commercial flock and reared in open-sided naturally ventilated pens in the experimental poultry farm belonging to the Faculty of Agriculture, Ain Shams University.

Feeding and management: All birds were fed ad libitum a commercial starter (for the first 4 weeks) and finisher (for the last 3 weeks) covering the recommended levels of NRC, 1984. The starter diet contained 21.43 crude protein and 3060 Kcal ME/kg diet, while the finisher diet provided 18% crude protein and 3117 Kcal ME/kg diet (Table 1). All birds received the same managerial (ad libitum water supply and 24 hour-lighting period) and hygienic conditions throughout the experimental period.

Traits considered: The body weight, feed consumption and feed conversion at 4 and 7 weeks of age were recorded for each bird. The average daily gain was calculated between hatching and 4 weeks, between 4 and 7 weeks and between hatching and 7 weeks (marketing).

At 7 weeks of age, one hundered birds were randomly taken two hours prior to slaughter an approximatly 2 ml of blood was collected via heart puncture from each bird. All blood samples with EDTA as anticoagulant were centrifuged (6000rpm) for 10 minutes and plasma was then decanted and

stored at –20°C until assayed for cholesterol and triglyceride contents using commercial kits (Sclavo, inc., Masard Count., Wayne Nj 07470, USE).

At slaughtering the jugular vein and carotid artery were severed, dressing was undertaken, according to the standared procedure and the abdominal fat was carefully removed and weighed.

Table(1): The composition and nutritive value of the basal stater and finisher diet.

Ingredient	Starter (1-4) wheels	Finisher (4-7) weeds
Yellow corn	64.00	71.70
Soybean meal	20.00	15.00
Meat meal (60%)	11.00	7.50
Wheat barn	1.93	2.00
Corn oil	2.00	2.00
Limestone	0.30	0.50
Bone meal	-----	0.60
Sodium chloride	0.32	0.30
Vit. Min mixture	0.30	0.30
Methionine	0.15	----
Calculated analysis		
Crude protein%	21.43	18.00
Me (kcal/kg)	3060	3117
Calcium	0.95	0.95
Available phosphorus	0.48	0.44
Lys.	1.02	0.84
Meth.	0.50	0.35

Statistical analysis: The data were analyzed using GLM program and stepwise option of REG procedure of the SAS institute, inc (1985). Significant between treatment means tested for significant ($P<0.05$) by using Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The result of body weight gain, feed consumption, and feed conversion (Table2) showed no significant differences in body weight gain and feed conversion during the growth period for the experimental groups. Analysis of variance revealed significant differences ($P>0.05$) in the amount of feed consumed for chicks at the growth period.

Table (2): Average body weight gain, feed consumption and feed conversion at 1-4, 4-7 and 1-7 weeks of age.

Item	(1-4) weeks	(4-7) weeks	(1-7) weeks
Body weight gain (g)	816.3±5.60 [c]	1132.7±21.45 [b]	1949±56.54 [a]
Feed consumption (g)	1413.3±16.0 [c]	2666.7±54.6 [b]	4080±11.55 [a]
Feed conversion	1.730±0.03 [b]	2.350±0.11 [a]	2.090±0.07 [a]

The traits and amount of abdominal fat are given in Table (3). It apprehend that the variability in abdominal fat weight (AFW) in absolute values was halved when expressed as percentage of marketing body weight (EFP) (12.45 vs. 5.60%). While the means was same traits was (32.6 vs. 1.67%).

Table (3): Means and variation for blood constituents and abdominal fat

Item	Triglyceride (mg/dl)	Chloesterol (mg/100ml)	Abdominal fat weight (g)	(%)
Means	18.42	82.60	32.60	1.67
Coeff. of var. %	16.02	14.52	12.45	5.60

Correlation coefficients between abdominal fat expressed in grams as a percentage of marketing body weight (Table 4). The triglyceride and cholesterol showed high and comparable correlation with AFW (0.78 and 0.62, respectively) and AFP (0.81 and 0.64, resp.). These results were in agreement with the results obtained by Geriffin and Whitehead (1982) who concluded that selection for decreased fat content in broiler could be made on basis of blood triglyceride level, also, Bacon *et al.* (1989) estimated a correlation of 0.84 between triglyceride and AFW.

However, Hermier *et al.* (1984) showed that males of a line of broiler chickens selected for increased abdominal fatness had greater circulating levels of triglyceride than males of a line selected for decreased abdominal fatness. The present study showed that the marketing body weight was highly correlated with AFW and AFP. The relationships between abdominal fat and blood constituents suggest the appropriateness of the later variables as predicators of abdominal fatness.

Table (4): Correlation coefficients between body weight gain and blood constituents at marketing

Item	Abdominal fat weight (g)	Abdominal fat weight as percentage of body weight
(1)Body weight at:		
1-4 wks	0.31**	-0.32**
4-7 wks	0.28*	-0.45**
1-7 wks	0.32**	-0.48**
(2)Blood constituents at marketing:		
Triglyceride	0.78**	0.81**
Cholesterol	0.62**	0.64**

Prediction equations: Regression equation of abdominal fat weight on body weight, concentration of plasma triglyceride and cholesterol together and accuracy of prediction (R^2) values are given in table (5).

Table (5): Regression equations to predict abdominal fat (gm).

Prediction equation	Intercept	Constants of the regression equations			Accursy (R^2%)
		Marketing body weight	Plasma cholesterol	Triglyceride	
PE_1	6.53	-	-	1.22	55.1
PE_2	22.61	0.032	-	-	13.5
PE_3	19.42	-	0.185	-	29.6
PE_4	7.55	-	0.045	1.321	58.2

Prediction of abdominal fat at weight using triglycride concentration alone PE was more accurate than based on body weight alone PE_2 or cholesterol concentration alone PE_3.

However adding cholesterol concentration to triglyceride (the least predictor) to formulate PE_4 was not useful in increasing accuracy of prediction (R^2=58.2 vs. 25.1%), the correlation between the two plasma constituents being quite high(r=0.87).

Prediction of the percentage of abdominal fat using the same three predictors is shown in table (6).

It appears that expression the abdominal fat weight as percentage of body weight was associated with slight increase in prediction accuracy using cholesterol concentration (R^2=48.4 vs. 29.6% and morlasting body weight (R^2= 19.8 vs 13.5%) as independent variate.

The results in this permit to use the plasma triglyceride (PTG) content (mg/dl) as a reasonably accurate predictor for abdominal fatness when expressed in grams marketing body weight by the equation:

$$AFW = 6.53 + 1.22\ PTG\ (R^2 = 0.551)$$

And when expressed as percentage of marketing body weight using the equation:

$$AFP = 0.486 + 0.116\ PTG\ (R^2 = 0.461)$$

Table (6): Regression equations to predict percentage abdominal fat of marketing body weight.

Prediction equation	Intercept	Constants of the regression equations			Accuracy (R^2%)
		Marketing body weight	Plasma cholesterol	Triglyceride	
PE_5	0.426	-	-	0.116	54.6
PE_6	5.203	0.001	-	-	19.8
PE_7	1.302	-	0.012	-	38.4
PE_8	0.642	-	0.004	0.095	62.4

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J. Agric. Sci. Mansoura Univ., 27 (2), February, 2002

التنبؤ بكمية دهن البطن فى بدارى اللحم باستخدام بعض قياسات الدم.

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درست إمكانيات التنبؤ بكمية دهن البطن اعتمادا على مقاييس مأخوذة على الحيوان الحى باستخدام ١٢٠ طائر من سلالة الأجور إيكرز وقد اشتملت المقاييس التى استخدمت وزن الجســـم (عند الفقس وعند عمر ٤ و ٧ أسابيع وهو عمر التسويق) وبعض مقاييس الدم (تركيز الجلسريدات الثلاثية والكوليسترول فى البلازما) كما قدر دهن البطن فى صورة الوزن بالجرام والوزن معـــبرا عنه كنسبة مئوية من وزن الجسم عند التسويق.

ظهر أن معامل ارتباط الدهن البطنى معبرا عنه بالجرام أو كنسبة مئوية من وزن الجسم عند التسويق عاليا مع تركيز الجلســـريدات الثلاثيـــة (٠,٧٨ و ٠,٨١ علـــى التوالـــى) وتركـــيز الكوليسترول (٠,٦٢ و ٠,٦٤ على التوالى) فى الدم, ومتوسطا مع وزن الجســـم (٠,٢٨ الـــى ٠,٣٢ و ٠,٣٣ الى ٠,٤٨ على التوالى).

وقد اتضح أن تصحيح البيانات على وزن تسويق ثابت يؤدى الى نقص كبير فى قيمـــة معامل ارتباط دهن البطن مع وزن الجسم ومعدل الزيادة اليومية بحيث أصبحت هذه الارتباطـــات غير معنوية. وقد صحب هذا التصحيح ارتفاعا طفيفا فى قيمة معاملات ارتباط دهن البطـــن مـــع تركيز الجلسريدات الثلاثية وتركيز الكوليسترول فى بلازما الدم.

وقد قدمت الدراسة بعض معادلات الانحدار لاستخدامها فى التنبؤ بدهن البطن عند عمـــر ثابت أو وزن ثابت. واتضح أنه عند ذبح الطيور على عمر ثابت (٧ أسابيع) يكون التنبؤ بـــالدهن البطنى باستخدام الجلسريدات الثلاثية فقط أكثر دقة من التنبؤ المبنى على اســـتخدام وزن الجســـم بمفرده أو تركيز الكوليسترول بمفرده وقد لوحظ أن ضم تركيز الجلسريدات الثلاثية والكوليسترول فى بلازما الدم فى معادلة تنبؤ واحدة لم يسفر عنه زيادة مفيدة للتنبؤ, وأن تصحيح بيانات الـــوزن عند التسويق زاد من دقة كفاءة الجلسريدات الثلاثية فى التنبؤ بدهن البطن بمقدار ٢٣%.

وقد أفاد البحث فى إمكانية استخدام الجلسريدات الثلاثية فى بلازما الدم كمقيـــاس دقيـــق للتنبؤ بدهن البطن فى بدارى اللحم فيما يلى:-

- وزن دهن البطن بالجرام عند عمر ذبح ثابت باستخدام المعادلة :-

وزن دهن البطن بالجرام= ٦,٥٣ + ١,٢٢ فى (تركيز الجلسريدات الثلاثية فى بلازما الدم) بدقـــة تنبؤ ٥٥,١%

- وزن دهن البطن كنسبة من وزن الجسم عند عمر ذبح ثابت باستخدام المعادلة:

%لدهن البطن= ٠,٤٨٦ + ٠,١١٦ فى (تركيز الجلسريدات الثلاثية فى بلازما الدم) بدقـــة تنبـــؤ ٤٦,١%.