Nigerian J. Anim. Sci. 2020 Vol 22 (2):155-162 (ISSN:1119-4308)

Carcass traits of broiler chickens as influenced by stocking density, calorie: protein ratio and season

Ademulegun, T.I[*], Adeyemo G.O. [**]and J.A. Olupona J.A. [***]

[*]*Animal Health and Production Technology Department,Rufus Giwa Polytechnic Owo;*
[**]*Department of Animal Science, University of Ibadan, Ibadan.*
[***]*Federal College of Animal Health and Production, Ibadan.*

Corresponding Author: *tadext4@gmail.com:* ***Telephone Number:*** *+2348032951503*

Target Audience: *Poultry Farmers, Nutritionists, Broiler Processors*

Abstract

This study was carried out to assess the effect of stocking density, protein and energy levels, and season on the carcass traits of broiler chickens. In a 6x3x2 factorial arrangement using completely randomized design, six diets with three metabolisable energy(ME kcal;/kg) and two crude protein(%) levels combination: 3106.00 and 23.00(control, diet 1); 3112.00 and 21.70(Diet 2); 2928.00 and 23.40(Diet 3); 2933.00 and 21.90(Diet 4); 3227.00 and 23.10(Diet 5); 3230.00 and 21.80(Diet6),were formulated. Three stocking densities(birds per m^2):10,Low SD(LSD);12,Recommended SD(RSD); and 14,High SD(HSD),were used in Late Wet Season(LWS),August-November) and Late Dry Season(LDS,February-April). In a seven-week feeding trial, 576 one-week old broilers were assigned to the respective diets and stocking densities. The percentage prima cuts(Dressed weight(DW),Breast(BR), Drum Stick(DS), Thigh(TH),Wing(WG), Back(BK), and abdominal fat(AF) was determined.Season significantly affects percentage BR, DS, WG, and BK with LDS having higher values for BR, WG and BK. Stocking density had significant effect on % DW, WG and BK with HSD and RSD having higher and similar DW and BK. Diets 1-5 had higher and similar %DS while diets 5 and 6 had higher and similar %AF. Late dry season, stocking 14birds/m^2 and diet with 3045ME/kg and 20.24% crude protein optimised the prima cuts and abdominal fat.

Key Words*: Broiler chickens, Stocking density, Season, Protein: Energy, Carcass traits.*

Description of Problem:

Poultry meat is food source with high biological protein value, has a relatively low fat content; has high digestibility, contains iron, some of the vitamins in the B group and has superior organoleptic quality (1). With these nutritional characteristics, the chicken meat is appreciated by consumers and occupies a special place in human diet. Yield is a method of measuring profit for processors, processing efficiency, or ready-to-cook (RTC) yield, is the most popular method of determining profit for poultry processors and is based on carcass weight (output) and live weight(input), this is also designated as dressing percentage(2). An average value for the (RTC) yield for processors is 70- 78% depending on the culture of processor and mode of chilling in terms of meat processing industry and consumers' interests, fattened chicks should be characterized by a good dressing percentage, desired conformation, as much meat on the carcass as possible, an optimal distribution of fat tissues and appropriate skin colour (3). In addition to these, the shares of major basic carcass parts (breast, drumsticks and thighs), the presence of certain tissues in them, as well as the chemical composition of the muscular tissue are regarded as vital parameters determining broiler meat quality (4). Carcass and meat quality properties are under significant effect

of biological factors which are determined by genetic potential, sex and age of the animal, (5) and conditions of rearing and nutrition in different housing systems (6;7). Rearing of broilers in lower stocking density tends to provide more intensive growth and higher absolute yield of processed carcass better body development and higher shares of carcass parts which contain more meat especially breast (8).However,(9)observed no significant difference in percentage weight, relative weight of breast and abdominal fat in birds raised on 5, 10, 15, and 20 birds per m^2 and 16, 20, and 24 birds per m^2 raised for 35days. Dietary protein and energy levels or energy to protein (E: P) ratio, besides its determinant effect on growth performance of broiler chicks has a marked effect on the quality of their carcasses viz; yield of edible meat and fat content (10;11). Several studies have shown that environmental temperature has an effect on carcass composition and meat yield (12). Since the primary goal of going into broiler production is to maximize the final body weight or carcass yield, however, this yield is under the influence of environmental factors such as; conditions of rearing and nutrition and different housing systems. Consequently, this study aims at examining the individual and interactive effect of stocking density, energy and protein content and season on the carcass traits of broiler chickens.

Materials and Methods

Experimental site

The experiment was conducted at the poultry unit of the Teaching and Research Farm, University of Ibadan, Nigeria. The periods of the experiment were August to November (Late wet season (LWS) with an average temperature of 25.44^{o}C and relative humidity of 83.52%, and February to April (Late dry season (LDS) with an average temperature and relative humidity of 27.77^{o}C and 74.34% respectively.

Experimental design

The experimental design was a complete randomized design (CRD) in a 6x 3x2 factorial arrangement. Six diets with three metabolisable energy (ME kcal;/kg) and two crude protein (%) levels combination; 3106.00 and 23.00(control, diet 1); 3112.00 and 21.70 (Diet 2); 2928.00 and 23.40 (Diet 3); 2933.00 and 21.90(Diet 4); 3227.00 and 23.10(Diet 5); 3230.00 and 21.80 (Diet 6), were formulated as shown in Tables 1 and 2. Three stocking densities (birds per m^2); 10, LowSD (LSD); 12, RecommendedSD (RSD); and 14, HighSD (HSD), were used.

Experimental birds, distribution and management

For each season, five hundred and seventy six (576) one-week old Arbor-Acre broilers were assigned to the three stocking densities and six diets interaction at the rate of eight (8) birds per interaction unit with four replicates each. Birds were housed in an open side house. Thermo hygrometers were placed at strategic points to monitor temperature and relative humidity. Vaccination and medication were administered as recommended by the hatchery operator. Feed and water were provided *ad libitum*.

Collection of data

At the end of week eight eighteen (18) birds per stocking density (equivalent to nine (9) birds per diet), with weight close to the average of the group, were selected and fasted overnight, sacrificed, scalded in hot water de-feathered and eviscerated. The relative weights of dressed carcass, prima cuts: (Thigh(TH); Breast(BR); Drumstick(DS); Wing(WG); Back(BK)) and abdominal fat expressed as percentage of live weight as described by (13).

Table 1: Gross composition of the broiler starter diets

	DIETS (D)					
Ingredient	1	2	3	4	5	6
Maize	49.00	52.00	55.00	56.00	52.15	54.35
Wheat offal	5.00	5.00	4.65	5.00	0.00	0.00
FFSB	8.65	8.00	5.00	7.12	9.50	9.50
GNC	25.00	23.00	25.00	22.00	23.50	22.00
Fish Meal	4.00	3.55	5.00	4.50	5.00	4.50
Palm oil	3.00	3.00	0.00	0.00	4.50	4.30
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00
Oyster shall	1.50	1.50	1.50	1.50	1.50	1.50
Salt [NaCl]	0.25	0.25	0.25	0.25	0.25	0.25
Broiler Premix	0.25	0.25	0.25	0.25	0.25	0.25
DL –Meth:	0.10	0.11	0.10	0.10	0.10	0.10
L-Lysine	0.25	0.34	0.25	0.28	0.25	0.25
Total	100	100	100	100	100	100
Determined	Nutrients					
Crude Protein	23.03	21.74	23.40	21.92	23.13	21.80
ME[kcal/kg]	3106	3112	2928	2933	3237	3230
Crude protein	23.03	21.74	23.40	21.92	23.13	21.80
Ether extract	13.82	12.39	9.16	9.27	12.90	12.92
Ash	9.30	5.51	6.41	6.49	5.53	5.54
Crude fibre	3.03	2.93	2.90	2.95	2.67	2.66
NFE	50.82	57.43	58.13	59.37	55.77	57.08
Calculated	Nutrients					
L-Lysine	1.20	1.20	1.20	1.20	1.20	1.20
DL –Meth:	0.45	0.45	0.46	0.45	0.46	0.45
Cal:Pr.	135	143	125	134	140	148
Ca	1.93	1.90	1.99	1.96	1.99	1.95
Av.Ph	0.71	0.70	0.71	0.71	0.67	0.66

D1- Recommended protein &energy; D2-Lower protein & Recommended energy; D3-Recommended protein & lower energy; D4-Lower protein &lower energy; D5- Recommended protein & higher energy; D6- Lower protein & high energy; FFSB- Full Fat Soya bean; GNC- Ground Nut Cake; NaCl- Sodium chloride; Ca- Calcium; Av.Ph- Available Phosphorus;Ca:Pr- Calorie: Protein ratio.

Table 2: Gross compositions of the broiler finisher diets

	DIETS (D)					
Ingredient	1	2	3	4	5	6
Maize	58.50	59.00	58.50	59.00	59.74	60.68
Wheat offal	2.00	3.30	5.04	6.00	0.00	0.00
FFSB	15.40	16.07	12.00	12.00	18.00	18.00
GNC	15.00	12.50	17.50	16.02	12.00	11.00
Palm oil	3.81	3.80	1.60	1.60	5.00	5.00
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00
Oyster shall	1.50	1.50	1.50	1.50	1.50	1.50
Salt [NaCl]	0.25	0.25	0.25	0.25	0.25	0.25
Broiler Premix	0.25	0.25	0.25	0.25	0.25	0.25
DL –Meth:	0.11	0.13	0.11	0.13	0.11	0.12
L-Lysine	0.18	0.20	0.25	0.25	0.15	0.20
Total	100	100	100	100	100	100
Determined	Nutrients					
Crude Protein	20.11	19.01	20.24	19.14	20.29	19.00
ME[kcal/kg]	3231	3235	3046	3045	3356	3362
Ether extract	13.21	14.09	13.56	11.32	15.51	16.39
Ash	6.75	6.36	7.23	7.25	6.39	6.37
Crude fibre	2.68	2.85	2.92	2.94	2.73	2.62
NFE	57.25	57.69	56.05	59.35	55.08	55.62
Calculated	Nutrients					
L-Lysine	1.04	1.01	1.03	0.02	1.00	1.02
DL –Meth:	0.40	0.41	0.40	0.41	0.40	0.41
Cal:Pr	161	170	150	159	165	177
Ca	1.68	1.68	1.68	1.68	1.68	1.68
Av.Ph	0.63	0.64	0.65	0.66	0.61	0.61

D1- Recommended protein &energy; D2-Lower protein & Recommended energy; D3-Recommended protein & lower energy; D4-Lower protein &lower energy; D5- Recommended protein & higher energy; D6- Lower protein & high energy; FFSB- Full Fat Soya bean; GNC- Ground Nut Cake; NaCl- Sodium chloride;Ca- Calcium; Av.Ph- Available Phosphorus; Ca:Pr- Calorie: Protein ratio.

Statistical analysis:

Data generated were subjected to analysis of variance using General Linear Model (GLM) Of SAS software 9.2 (14). Significantly different means were separated using Duncan Multiple Range (DMR) test, with level of significance set at $p<0.05$.

Results

Table3 indicated the main effect of season on carcass characteristics of broiler chickens. There was significant effect of season ($p<0.05$) on percentage breast (BR), drum stick (DS), wing (WG) and back (BK) with LD having higher values for %Br (19.74), %WG (8.06) and % BK (16.47) while LW had higher value for %DS (10.89). The effect of stocking density on carcass characteristics of broiler chickens is shown in Table 4. The percentage dressed weight (%DW), WG and BK were significantly different among the three stocking densities (SD) with HSD having higher %DW (72.94), and %BK (16.07) that was similar to that of RSD. The % WG was also higher in SD 14b/m^2 (8.16) than in other stocking densities. Table 5 reflected the influence of energy and protein level the carcass trait of broiler chickens There was

significant ($p<0.05$) effect of calorie: protein ratio on %DS and abdominal fat (%AF). The %DS varies from 10.17 for diet 6 to 10.77 for diet 3 with diet 3 value similar to that of diets 1, 2, 4 and 5. While the values for diets for 6, 5, 4, 2 and 1 was also similar. Diets 5 and 6 had higher and similar %AF (2.68 and 2.67) with diets 1 & 2 while diets 3 and 4 had similar and least %AF (2.09 and 2.04).There was no significant ($p>0.05$) interactive effect of season x stocking density and calorie:protein ratio on carcass trait. (Table 6)

Table 3: Effects of season on carcass traits of broiler chickens

							Parameter
Season	DW%	BR%	TH%	DS%	WG%	BK%	AF%
LD	72.59	19.74^{a}	11.14	10.30^{b}	8.06^{a}	16.47^{a}	2.29
LW	72.41	18.85^{b}	11.33	10.89^{a}	7.85^{b}	14.87^{b}	2.5
SEM	0.22	0.19	0.07	0.08	0.05	0.15	0.07
p-value	NS	0.02	NS	0.0002	0.04	<0.0001	NS

a, b: Means on the same column with different superscripts are significantly different($p<0.05$ LD: Late Dry; LW: Late wet**.** SEM: Standard Error of Mean; DW: Dressed Weight; BR: Breast; TH: Thigh DS: Drum Stick; WG: Wing; BK: Back; AF: Abdominal Fat, NS: Not Significant

Table 4: Effect of stocking density on carcass trait of broiler chickens

							Parameter
SD(bird/m^2)	DW%	BR%	TH%	DS%	WG%	BK%	AF%
10	72.73^{ab}	19.54	11.16	10.64	7.89^{b}	15.88^{a}	2.46
12	71.82^{b}	19.44	11.17	10.43	7.81^{b}	15.07^{b}	2.41
14	72.94^{a}	18.91	11.37	10.7	8.16^{a}	16.07^{a}	2.31
SEM	0.22	0.18	0.08	0.07	0.05	0.15	0.07
P-value	0.045	NS	NS	NS	0.013	0.005	NS

a, b: Means on the same column with different superscripts are significantly different($p<0.05$). SD: Stocking density, SEM: Standard Error of Mean; DW: Dressed Weight; BR: Breast; TH: Thigh DS: Drum Stick; WG: Wing; BK: Back; AF: Abdominal Fat NS: Not Significant

Table 5: Effect of energy and protein content on carcass trait of broiler chickens

							Parameter
Diet	DW%	BR%	TH%	DS%	WG%	BK%	AF%
1	73.23	19.38	11.56	10.75^{ab}	7.93	15.2	2.36abc
2	71.9	18.6	10.96	10.73^{ab}	7.9	15.83	2.52ab
3	73.06	19.91	11.47	10.77^{a}	7.97	15.99	2.09bc
4	72.03	19.38	11.07	10.56 ^{ab}	7.89	15.53	2.04c
5	72.3	18.67	11.22	10.58 ^{ab}	8.1	15.57	2.68a
6	72.47	19.83	11.12	10.17^{b}	7.93	15.91	2.67 a
SEM	0.22	0.19	0.08	0.8	0.05	0.15	0.07
p-value	NS	NS	NS	NS	NS	NS	NS

a, b,c: Means on the same column with different superscripts are significantly different($p<0.05$). SEM: Standard Error of Mean; DW: Dressed Weight; BR: Breast; TH: Thigh DS: Drum Stick; WG: Wing; BK: Back; AF: Abdominal Fat, D1- Recommended protein and energy; D2- Lower protein and Recommended energy; D3- Recommended protein and lower energy; D4- Lower protein and lower energy; D5- Recommended protein and higher energy; D6- Lower protein and high energy. NS, Not significant

Table 6: Interactive effect of season, stocking density and calorie: protein ratio on carcass traits of broiler chickens

Season	Sd(bird/m²)	Diet	DW (%)	Br (%)	Th (%)	Ds (%)	Wg (%)	Bk (%)	Af (%)
LD	10	1	73.60 a-e	20.41	11.07	10.31	7.56	16.74	2.56
		2	75.25ab	19.60	10.96	10.61	7.80	17.18	2.71
		3	75.68a	22.90	11.21	10.78	8.42	16.34	1.92
		4	72.01 c-g	20.10	11.00	10.18	7.98	16.04	2.31
		5	73.86 a-d	19.59	11.00	9.66	8.17	17.44	3.13
		6	71.92 c-g	18.86	11.01	10.52	8.13	16.54	2.13
	12	1	72.43b-g	20.61	11.43	9.54	7.74	14.77	1.87
		2	69.60gh	18.86	11.04	10.50	7.95	15.98	2.03
		3	71.27c-g	20.25	10.43	10.67	7.85	17.12	2.21
		4	70.07fgh	18.63	11.28	10.34	7.95	15.98	2.15
		5	71.46c-g	18.34	11.56	10.49	7.97	16.08	2.27
		6	71.71 c-g	20.56	10.68	9.65	7.92	15.82	2.68
	14	1	72.38 b-g	19.58	11.84	10.63	8.31	15.36	1.95
		2	73.87 a-d	19.77	10.45	10.30	8.37	17.50	2.79
		3	72.79 a-g	18.97	11.18	10.53	8.55	16.81	1.82
		4	72.29 b-g	20.23	11.50	10.82	8.42	16.12	1.52
		5	73.59 a-e	18.74	11.09	10.34	8.10	17.58	2.55
		6	72.81 a-g	18.91	11.70	9.49	7.88	17.44	2.54
LW	10	1	73.67 a-e	18.33	12.00	11.67	8.00	15.33	2.00
		2	67.33h	17.00	10.67	10.33	7.67	14.67	2.67
		3	71.67 c-g	19.33	11.67	11.00	7.33	15.00	1.67
		4	70.67 d-g	18.00	10.67	11.00	7.67	15.00	3.23
		5	73.40 a-e	19.33	11.33	11.00	8.00	15.33	3.23
		6	73.67 a-e	20.67	11.33	10.67	8.00	15.00	3.23
	12	1	74.33abc	19.33	11.67	11.00	8.33	14.33	2.88
		2	72.67a-g	18.33	11.33	11.00	7.67	14.67	3.07
		3	73.43a-e	19.67	12.33	10.67	7.67	14.33	2.54
		4	73.33 a-e	20.00	10.67	10.00	7.33	14.67	2.20
		5	70.50e-g	18.67	11.33	11.00	8.33	12.00	2.60
		6	71.07d-g	20.00	10.33	10.33	7.00	15.33	2.51
	14	1	72.93a-f	18.00	11.33	11.33	7.67	14.67	2.91
		2	72.67a-g	11.33	11.67	11.67	8.00	15.00	1.82
		3	73.50a-e	18.33	12.00	11.00	8.00	16.33	2.38
		4	73.83a-d	19.33	11.33	11.00	8.00	15.67	2.06
		5	71.00d-g	17.33	11.00	11.00	8.00	15.00	2.43
		6	73.67a-e	20.00	11.67	10.33	8.67	15.33	5.33
	SEM		0.22	0.19	0.08	0.08	0.05	0.15	0.08
	p-value		0.014	NS	NS	NS	NS	NS	NS

a – h: Means on the same column with different superscripts are significantly different($p<0.05$). DW: Dressed Weight; BR: Breast; TH: Thigh DS: Drum Stick; WG: Wing; BK: Back; AF: Abdominal fat. LD: Late Dry; LW: Late wet**.** SEM: Standard Error of Mean, SD: Stocking DensityD1- Recommended protein and energy; D2- Lower protein and Recommended energy; D3- Recommended protein and lower energy; D4- Lower protein and lower energy; D5- Recommended protein and higher energy; D6- Lower protein and high energy. NS- Not Significant.

Discussion

The observed lower percentage BR and higher percentage DS during LW could have been due tom the fact that the climatic condition during the late wet season (LW) favoured lipid oxidation rather than glucose metabolism, since breast muscles consumed glucose as primary substrate for energy while hind limb muscles have greater capacity for lipid oxidation (12). Hence, the result of the present study was contrary to the observation of (12, 15). The similar %DW and %AF among birds raised on LSD and HSD in this present study agreed with the observations of (16) that there was no significant influence of stocking density on carcass and abdominal fat yield relative to body weight of Ross x Cobb broilers raised for 50days on stocking densities 9, 10, 12 and 14 birds/m^2 and that of male Ross broilers raised at 10, 14 and 18birds/m^2 respectively. The non- significance effect of stocking density on the hind limbs (thighs and drum sticks) agreed with the submission of (8) that rearing broilers in lower stocking density tends to provide more intensive growth and higher absolute yield of processed carcass parts, better development of hind limbs expressed through value of thigh girth doesn't follow adequately the increase of body mass, so the share of thighs and drumsticks did not increase significantly. The non- significant effects of the diets on % DW, % BR; %TH; % WG and % BK was in line with findings of (11) that carcass yield, breast meat yield, and thigh were not influenced by the concentration of dietary energy and protein. Birds fed diets with recommended energy level and those on higher energy levels gave significantly higher abdominal fat percentage (%AF). This result on energy: protein ration was consistent with (10) who found that higher dietary energy significantly increased abdominal fat.

Conclusion and Application:

1) Stocking density, Season and Calorie: Protein ratio, singly affects carcass traits of broiler chickens.
2) Stocking density 14birds/m^2; late dry season and diet with 3045ME/kg and 20.24% crude protein optimised the prima cuts and abdominal fat.

References

1. Rogowski, B. (1980): Meat in human nutrition. World Review of Nutrition and Dietetics, Ed. G.H. Bourne, Karger, pg 34-46.
2. Aduku, A.O and Olukosi, J.O. (2000). Animal products, processing and handling in the tropics (2nd eds) Living Book Series, publication Abuja, Nigeria. ISBN- 978-125- 742-3
3. SnezanaBogosavljevic-Boskovic; S. Mitrovic; Vera Radovic and V. Doskovic(2005). The effects of season and rearing systems on meat quality traits. *Biotechnology in Animal Husbandry.* 21(5-6): 229 - 233.
4. Ristic M. (2003). Fleischqualitat von broilern der Okologishen production, Biotechnology in Animal Husbandry 19(5-6), pp. 335- 343, Institute for Animal Husbandry Belgrade- Zemum.
5. Abdullah, A. Y; Matarneh, S. K (2010). Broiler performance and the effects of carcass weight, broiler sex, and post chill carcass aging duration on breast fillet quality characteristics. The *Journal of Applied Poultry Research* 19; 46- 58.
6. Skrbic Z; Qavlovski Z; Lukic M. (2007): Utieajduzinetova u razlicitimsistemimagajenjanaklanicneosobi nebrojlerskinpilicagenotipaRedbro. *Biotechnology. Journal. a u Stocarstvu* 23(3-4), 67-74
7. Marcus Adela; IoanVacaru-Opris; Gabi Dumitrescu; Adrian Marcu; Liliana PetculescuCiochina; MarioaraNicula; Dorel Dronca; BarkolomeuKelciov(2013). Effect of diet with different energy and

protein levels on breast muscle characteristics of broiler chickens. Animal Science and Biotechnologies 46(1) 333-340.

8. Skrbic, Z; Pavlavski, Z; Lukic, M; Peric, L; Milosevic, N; (2009). The ffect of stocking density on certain broiler welfare parameter *Biotechnology in Animal Husbandry*; 25:11-21.
9. Ravindran V; D. V Thomas; D.G Thomas and P.C Morel (2006). Performance and welfare of broiler as affectecd by stocking density and Zinc bacitracin supplementation. *Animal Science Journal;* 77:110-116.
10. Nguyen, T.V; C. Bunchasak and S.Chantsavang, (2010). Effects of dietary protein and energy on growth performance and carcass characteristics of betong chickens (Galiusdomestions) during growing period. *International. Journal of Poultry Science*, 9:468-472.
11. Hosseini-Vashan, S.J; A.R. Jafari-sayadi; A.Golian; Gh. Motaghinia; M Nawvari and M. Hamedi (2010). Comparison of growth performance and carcass characteristics of broiler chichkens fed diets with various energy and constant energy-to-protein ratio. *Agricultural Journal* 5(4): 253-258.
12. LU, Q. J.Wen and H. Zhang (2007): Effect of chronic heat exposure onfFat deposition and meat quality in two genetic types of chicken. *Poultry Science*. 86:1059-1064.
13. Shahin K.A and Elazeem, F.A (2005). Effects of breed, sex and diet and their interactions on carcass composition and tissue weight distribution of broiler chickencs. Arch. Tierz., Dummerstorf 48 ;(6), 612-626
14. SAS (2008). User's Guide: Statistics Version 9.2 SAS Institute Inc. Cary, NC. USA
15. Yalcin, S. S; Ozkan, L; Turkmut AND Siegel, P.B. (2001). Responses to heat stress in Commercial and Local broiler stocks. 1. Performance traits. *British Poultry Science*. 42:149- 152.
16. Nogueira, W. C. L; Velasquez, P. A. T; Furlan, R.L; Macari, M. (2013). Effect of dietary energy and stocking density on the performance and sensible heat loss of broilers reared under tropical winter conditions. *Brazillian Journal of Poultry Science*; vol 15(1): 53- 58.