Impact of fed corn based diets substituted with graded levels of potato chips scraps on growth performance, feeding behavior and economic efficiency of Japanese Quails.

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ABSTRACT: The experiment was done for assess the utilization of potato chips scraps (PCS) as a substitute with a corn in basal diet on feeding behavior patterns, growth performance and economic efficiency of Japanese quails. A total number of 144 unsexed Japanese quails during age of 14 days were distributed randomly allocated into three treatments with each treatment further subdivided into four replicates. The treatment one received a basal diet as a control, while treatments 2 and 3 had yellow corn replaced with two levels of PCS, i.e., 4% and 8%, respectively. The quail were raised under the same management conditions with ad libitum feed and water offered. Various parameters, such as body weight gain, body weight, feed intake, feed conversion ratio, feeding behavior patterns and economic efficiency were appraised. Our results showed that the birds received (PCS) 4% and 8% higher significantly ($p \leq 0.05$) value of body weight gain , body weight, performance index, economic efficiency, intestine length, total lipids, cholesterol, triglycerides and HDL than control group. While, there were no found significant difference between treatments for feed consumption. Moreover, the high ($p \leq 0.05$) value of LDL was found in control group than other treatments group. In conclusion, the supplementation of the diet with PCS at the levels of 4% and 8% did not have any adverse impact on the bird's performance, feeding behavior patterns and economic value of Japanese quails through the growing period.

KEYWORDS: potato chips scraps, performance, behavior, economic efficiency, Japanese quails

1. Introduction

Poultry production is significantly affected by poultry feed price, which represent 70-80% of total poultry production[1]. Corn, a conventional carbohydrate source, is commonly used as its low fiber, high energy content, pigments and essential fatty acids and comprises 50-70% of the total diet. [2]. human can used corn grain for food in Egypt, For this reason it found the opposition between human and poultry nutrition has caused an high in the price of poultry feedstuffs [3].Thus, this problem give rise to increase price of poultry products [1]. From point of view, to reduce the feeding costs we need dispose of the imported and expensive feedstuff either corn or soybean meal and replace them with several available and cheap byproducts and wastes as alternatives for energy and protein sources. In order to decrease the cost of poultry products, alternative energy sources that can replace corn without negatively impacting efficiency and cost are needed [4]. Several alternative ingredients have been studied, including cassava root meal, water yam, , sweet potato, pearl millet and potato chips scraps. [5, 6, 7]. Potato chips scraps have been found to be a partial substitute for yellow corn at 5% and 10%, resulting in improved performance and economic efficiency of broiler chicks [8].. Furthermore, Rahnema et al., [9] found that growth performance and economic efficiency had improved in case of use 7.5% PCS in broiler diets. Recently, The researchers are interested in using the economical agro-industrial wastes for poultry nutrition [10]. Therefore, the main goal of this experiment is to interrogate issue of supplemental dietary potato chips scraps on the growth performance and feed efficiency of quails.

2. Materials and methods

Ethical Approval

The experiment was performed in the poultry research farm, faculty of agriculture, new valley university, Egypt.

The study was conducted from July to September 2022.Ethical approval No (03-3-6-2023-3).

Experiment design and diet:

A number of 144 unsexed Japanese quail at age 14 day with body weight (62 g) were randomly divided into three treatments (48 each). Each treatment was distributed into 4 replicates (12 chicks). The treatment one received basal diet (control). While, treatments 2and3 replacement of corn with two levels of potato chips scarps (PCS) 4% and 8%, respectively. The birds were raised in floor pen with covered a wood shaving. Moreover, the feed and water offered ad libitim. The obtained potato chips scarps waste was prepared and analysis in Table 1 according to methods of the Association of Official Analytical Chemists [11]. The ration was supplied with suitable vitamins and minerals premix to provide all indispensable nutrient requirements. The experimental rations were formulated according to NRC [12] in Table 2.

Housing and management

quail chicks were weighed, separated and kept under the same of management, hygiene and environment conditions. All birds were raised on suitable floor pen covered with a wood shaving litter depth 2.5 Cm. The birds were reared under initial temperature at 35°C for the first 2 day of age then reduced gradually by 0.5 °C degree daily until reach to the comfort temperature 24 °C. The artificial light was used to provide 24 hour / day photo period. Cleaned water was offered during all the time and feed was provided ad libtum in the form of mash.

Growth performance of quails

The productive performance data was recorded weekly during period 14-42 day of age including individual body weight gain, live body weight, feed intake, feed conversion, performance index, protein efficiency ratio, Crude protein intake, Metabolizable energy intake and caloric efficiency ratio. Mortality rate was recorded during all period of experiment[13].

Carcass characteristics

number of 3 quail / replicate during end of the experiment were obtained then fasted for 12 hours and weighted then slaughtered and feathered. The following measurements were recorded: eviscerated carcass weight, breast weight, thigh weight and edible parts (liver, heart and gizzard) were pick up, weighed and estimated for each organ relative to live body weight. Moreover, the small intestine length was measured. Dressing % was determined according equation (dressing weight divided by live body weight × 100).

$$\text{Performance index} = \frac{\text{Body weight (kg)}}{\text{Feed conversion}} \quad (1)$$

$$\text{Crude protein intake (g)} = \text{feed intake (g)} \times \%\ \text{crude protein in the diet} \quad (2)$$

$$\text{Metabolizable energy intake (MEI)} = \text{feed intake (kg)} \times \text{Metabolizable energy (kcal / kg diet)} \quad (3)$$

$$\text{Protein efficiency ratio} = \frac{\text{Body weight gain (g)}}{\text{Protein intake (g)}} \quad (4)$$

$$\text{Caloric conversion ratio (CCR)} = \frac{\text{Metabolizable energy intake (MEI) Caloric}}{\text{Body weight gain (g)}} \quad (5)$$

Blood parameters

At total number of 12 birds /treatments were taken for blood samples at the end of experiment in tubes without EDTA. The obtained blood samples were centrifuged at 3000 rpm for 15 minutes to obtained serum. The obtained serum kept at -20°C until used to measure. Total protein, glucose, albumin, total lipids, triglycerides, cholesterol, HDL and LDL were measured by special kits obtained from EL-Gomhorya company by means of spectrophotometer. Moreover, the serum globulin was estimated as difference between total protein and albumen. Furthermore, Albumin/Globulin (A/G) ratio was calculated. Economic efficiency: The economic efficiency data of experiment was determined according to zewil et.all[14] equally the difference between feed cost and income. The cost of the experiment basal diet and PCS was estimated according to the local market price during carry out of the experiment in 2022.Also, the total revenue equally the marketing price of quail live body weight. Moreover, the net revenue equally the difference between total revenue and total feed cost. Also, the economic efficiency calculated as net revenue divided by total feed cost ×100 .the relative economic efficiency calculated as economic efficiency (treatment) divided by economic efficiency (control) ×100.

Table 1: chemical analysis of PCS

Chemical composition (PCS)	%
ME[1](kcal/kg)	5085
Dry matter	98
Crude protein	6.3
fat	31.9
ash	7.87
fiber	1.75
NFE	47.82
ME[1] value of PCS was calculated according to **Carpenterand Clegg (1956)**	

Behavioral observations

Quails behavior were directly observed for 3 period daily 2 day / week each period was 10 minutes which analyzed by using a scanning technique [15].

Statistical analysis:

the results obtained of experiment were statistically analyzed using the General Liner Model (GLM) Procedure of SAS Version 9.2 SAS[16]. All percentage values obtained were subjected to arcsine transform before statistical analysis. The Significant differences between treatment means were tested by Duncan's multiple range test [17]. One-way analysis of variance (ANOV) procedure was used. All results found from each treatment were statistically analyzed by using the following Model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

where:

- Yij = observed value
- μ = the overall mean
- Ti = Treatment effect (control, 4%PCS and 4%PCS)
- eij = random error

3. Results and discussion

3.1. Growth Performance

3.1.1. Live body weight and body weight gain

Results presented in Table 3 reveled that during first14 days the results indicated that there were no found significant differences of body weight and body weight gain between the treatments while, it found a significant (p≤0.05) difference in quails' body weight and weight gain from 21 to 42 day of age. The quails that were provided diets containing 4% Potato Chips Scraps (PCS) exhibited the greatest body weight gain and live body weight. These results align with the research conducted by Faddle[18] who found that quails that consumed 15% PCS had the highest LBW and BWG values throughout the experiment period. The nclusion of 5% PCS or an increase in the level of PCS to 7.5% in the diet led to significant increases in ADG [9]. Kpanja et al [19] explain that the incorporation of PPM up to level 15% in birds' diets positively impacted growth performance. In contrast, Zand and Foroudi [20] demonstrated that the addition of corn crunches waste (CCW) decrease (P≤0.05) the weight gain of broilers. Also, Rahnema et al., [21] showed that BWG had non-significant increases in the 5% PCS diet. Agwunobi[22]indicated that the inclusion of either potato or sweet potato in broiler diets had no adverse effect on BWG. Makled et al.,[8] reported that the BW and BWG of broilers that received 5% Corn Crunches Waste or 10% PCS instead of yellow corn were not found significantly affected compared to the control basal diet. Furthermore, it was recorded that levels of 17, 30, and 50% Corn Crunches Waste (CCW) in grower and finisher diets led to reduce in broiler chicks' weight (p≤0.05) [20].

3.1.2. Feeding behavior, feed intake and Feed conversion ratio of quails

Results presented in Table 3 and Fig. 1 represent the feed intake(FI) and feed conversion ratio(FCR) and feeding behavior during different growth stages feeding behaviors Analyses can enhanced the understanding of feed intake regulations [23] and the effects of breeding on performance traits [24]. The effect of dietary treatments groups on feed consumption had no significant difference during the grower period. This finding is in agreement with obtained by Rahnema [25, 21] showed that pigs can be used diet contained PCS, up to 25%during nursery, growing and finishing period. Also Rahnema et al., [9] stated that addition of 5% PCS in the broiler diet without any effect on increases in feed consumption. On the other

Table 2: The chemical composition of experimental diets

Ingredient	Control	T1	T2
Yellow corn	55.16	52.77	50.41
Soybean meal 44%	38.00	38.17	38.43
Gluten 60%	3.04	3.04	3.00
Oil	0.86	0.86	0.80
Limestone	1.32	1.32	1.32
Di-calcium phosphate	0.80	0.80	0.80
NACL	0.30	0.30	0.30
Premix[1]	0.30	0.30	0.30
Lysine	0.10	0.10	0.10
Dl-Methionine	0.12	0.12	0.13
PCS	0.00	2.21	4.41
Calculated analysis			
ME (kcal/kg)	2900	2930	2960
Crude protein	24.00	24.00	24.00
Ether extract	4.68	4.59	4.45
Crude fiber	3.86	3.85	3.87
Calcium	0.80	0.80	0.80
Phosphorus	0.30	0.30	0.30
Methionine	0.50	0.50	0.50
Lysine	1.30	1.30	1.30
Sodium	0.14	0.14	0.14

Ingredient composition and calculated analysis for control and treatments Control: basil Diet, T1: 4% potato chips scraps, T2: 8% potato chips scraps. [1] Each 3kg of vitamin mineral premix contains: vit A 1200000 IU, vit D3 300000 IU, vit E 10 g, vit K3 1000 mg, vit B1 1000 mg, vit B2 5 g, vit B6 1.5 g, vit B12 10 mg, folic acid 1 g, choline chloride 10 g, niacin 30 g, biotin 50 mg, pantothenic acid 10 g, manganese 60 g, iron 30 g, zinc 50 g, copper 4 g, iodine 300 mg, cobalt 300 mg, selenium 100 mg.

hand, inclusion of 7.5% PCS in the diet of broiler lead to a significant increase in FI [9]. Also, Van Wyhe et al., [26] demonstrated that increase feed intake seen at greater addition rates of potato chip scraps. The results also revealed that, the control group had the highest FCR while, quails fed diets-supplemented with 4%PCS or 8% PCS had the lowest FCR during periods from 14- 42 days of age. Similarly, Faddle, [18] demonstrated that the birds fed 5 or 15% potato chip scraps had the highest FC, while those fed 20% PCS had the lowest one during the starting-growing period, Zand and Foroudi,[20]indicated that fed broiler chicks on diet contained to corn crunches waste at levels of 17 and 35 % increased FCR and at level of 50%

Table 3: Effects of dietary inclusion with (potato chips scraps) on growth performance of quails.

Items	Dietary groups			P-value
	control	T1	T2	
Body weight(g/bird)				
Day 14	60±0.25	65±1.08	64±1.03	0.06
Day21	94±0.64^{b}	111±1.87^{a}	106±3.40^{a}	0.001
Day28	130±0.40	137±3.96	131±2.12	0.14
Day35	166±1.10^{b}	175±2.05^{a}	172±1.78^{a}	0.01
Day42	201±4.45^{b}	215±1.03^{a}	214±2.86^{a}	0.26
Body weight gain(g/bird)				
Day14-21	34±0.62^{b}	46±1.22^{a}	42±4.05^{a}	0.00
Day21-28	36±1.04	26±3.70	25±1.31	0.02
Day28-35	36±1.10^{b}	38±2.28^{a}	41±2.04^{a}	0. 29
Day35-42	35±3.66^{b}	40±1.93^{a}	42±2.28^{a}	0.21
Day 14-42	141±4.69^{b}	150±1.65^{a}	150±1.89^{a}	0.69
Feed consumption(g/bird)				
Day14-21	98±0.64	97±1.04	97±1.65	0.59
Day21-28	113±0.64	112±1.10	111±0.95	0.34
Day28-35	141±1.37	143±1.03	144±1.08	0.43
Day35-42	164±2.10	165±2.27	166±2.28	0.92
Day 14-42	518±3.68	517±2.32	518±4.50	0.98
Feed conversion ratio(g/g)				
Day14-21	2.88±0.05^{a}	2.11±0.06^{ab}	2.31±0.25^{b}	0.00
Day21-28	3.14±0.09^{b}	4.31±0.56^{a}	4.44±0.21^{a}	0.05
Day28-35	3.92±0.12	3.76±0.26	3.51±0.17	0.44
Day35-42	4.69±0.41	4.13±0.31	3.95±0.16	0.22
Day 14-42	3.67±0.10^{a}	3.45±0.04^{b}	3.45±0.03^{b}	0.59

a,b,c,d Means within the same row with different letters are significantly different ($p \leq 0.05$). Control: basil Diet, T1: 4% potato chips scraps, T2: 8% potato chips scraps

FCR had decreased ($p<0.05$). Our results are in contrast to Agwunobi [22] who recorded broiler fed diet containing either sweet potato or potato exhibited did not affect on the feed conversion ratio. Makled et al.,[8] indicated that there were no found significant differences in FC and FCR of broilers received 10% PCS or 5% % corn crunches waste instead of corn between all treated groups. Dugass (2020) indicated that replacement 5-15% of potato peel meal by maize had no significant difference in feed conversion ratio of broilers compared with control one. Ekenyem et al., [27] showed that there were no different effect ($P>0.05$) in feed conversion ratio. Rahnema et al.,[9] found that addition of 7.5% potato chips scraps in broiler diets did not change feed conversion ratio.

3.1.3. Carcass traits

Although supplementing quail diets containing different percentages of PCS did not affect on the carcass traits, except for intestine length, which increased significantly in comparison with the control group, these results are similar to found by Faddle [18], who stated that no significant

differences in spleen, heart and gizzard percentages. However, liver percentages of birds fed PCS were significantly greater other treatments. Agwunobi [22] indicated that the dressing percentage and the weights of breast, drumstick, thigh and wing had no notable effects compared with other treatments. Similarly, Zand and Foroudi [20] revealed that the broiler fed diet contained CCW had no found effect on heart, liver and length of gastrointestinal tract. Dugass [28] also indicated that broiler fed diet containing potato peel meal substituted with corn grain at level 5-15% showed that the carcass yield and internal organ (gizzard, kidney, heart, and liver) were not affected. Akira et al., [29] similarly showed that broiler fed diet containing dry heat processed sweet potato had no significantly effect on (P>0.05) the internal organs .

Table 4: Effects of dietary inclusion with (potato chips scraps) on carcass traits of quails.

Items	Dietary groups			P-value
	control	T1	T2	
Dressing %	75±0.62	73±0.72	72±1.12	0.20
Breast weight(g)	105±5.41	111±1.95	101±4.71	0.28
Thigh weigh(g)	54±2.44	59±2.86	60±1.70	0.24
Liver %	1.29±0.08	1.21±0.09	1.24±0.08	0.80
Gizzard %	1.29±0.09	1.22±0.04	1.29±0.12	0.80
Heart %	0.59±0.13	0.81±0.07	0.78±0.11	0.34
Intestine length(cm)	40 ± 2.35^{b}	48 ± 1.10^{a}	48 ± 2.87^{a}	0.04
Caeca length(cm)	10±0.40	11±0.40	11±0.25	0.18

a,b,c,d Means within the same row with different letters are significantly different (p ≤0.05). Control: basil Diet, T1: 4% potato chips scraps, T2: 8% potato chips scraps

3.1.4. *Influence of Dietary (potato chips scraps on the Biochemical Parameters of quails.*

Data conferred in Table 5 showed that quails fed dietary 4% and 8% potato chips scraps(p ≤ 0.05) recorded high value of cholesterol, total lipids, HDL and triglycerides compared to the control group. In contrary, the high value of LDL was recorded in control group than those other treatments group. Furthermore, there were no found significant differences among treatments for blood parameters such total protein, globulin, glucose and A/G ratio The values concerning the performance index, metabolizable energy intake, protein efficiency ratio, crude protein intake and caloric conversion ratio are showed in Table 6 the obtained results cleared that the performance index of

Table 5: Effects of dietary inclusion with (potato chips scraps) on some serum metabolites and blood hematological profile of quails.

Items	Dietary groups			P- value
	control	T1	T2	
glucose(mg/dl)	186±2.04	186±1.29	185±1.44	0.96
Total protein(g)	5.7±0,09	5.87±0.13	5.55±0.11	0.19
albumin(g)	2.57 ± 0.06^{ab}	2.62 ± 0.04^{a}	2.40 ± 0.05^{b}	0.04
Globulin(g)	3.12±0.04	3.25±0.10	3.15±0.08	0.55
A/G ratio	0.82±0.02	0.81±0.02	0.76±0.02	0.18
Total lipids(mg/dl)	348 ± 3.49^{b}	366 ± 2.67^{a}	367 ± 2.59^{a}	0.00
cholesterol(mg/dl)	187 ± 0.86^{b}	195 ± 1.25^{a}	192 ± 1.93^{ab}	0.01
Triglycerides(mg/dl)	161 ± 2.78^{b}	171 ± 0.49^{a}	176 ± 2.23^{a}	0.00
HDL(mg/dl)	50 ± 1.65^{b}	67 ± 0.47^{a}	65 ± 0.86^{a}	0.00
LDL(mg/dl)	137 ± 2.51^{a}	128 ± 1.22^{b}	126 ± 2.28^{b}	0.01

a,b,c,d Means within the same row with different letters are significantly different (p ≤ 0.05). Control: basil Diet, T1: 4% potato chips scraps, T2: 8% potato chips scraps

quails fed on 4% PCS or 8% PCS was higher than performance index of control group. Data of crude protein intake, Protein efficiency ratio, metabolizable energy intake and caloric conversion ratio was similar to control group.

3.1.5. *Economic efficiency*

The economic efficiency results of feeding different experimental diets through the period of 6 weeks of age as quails fed diets supplemented with 4% or 8% PCS are presented in Table 5. It is evident that including 4% or 8% PCS in quail diets decreases feed price, feed cost, and total feed cost when compared with the control diet. Our results indicate that the best economic efficiency, net return, and relative economic efficiency values found in quails fed diets supplemented with 4% or 8% PCS. Similarly, Zand and Foroudi, [20] recorded that the corn crunches waste prices are nearly 75% of the maize prices and using of corn crunches waste in diets had decreased feed costs and increased gains. Faddle [18] also stated that lower feed costs and higher economic efficiency found in using PCS up to 20% substituted with yellow corn in broiler chick diets. Van Wyhe et al.,[26] cleared that the using PCS in broiler diets may lower overall feed costs. However, in contrast to Afolayan et al.,[30] indicated that fed laying hens diet containing sweet potato meal substituted with corn at level 20% exhibited there was no found significant differences for the feed costs per kg of egg production and laying performances.

Table 6: Effects of dietary inclusion with (potato chips scraps) on Performance index, Crude protein intake, Metabolizable energy intake, Protein efficiency ratio and Caloric conversion ratio of quails

Items	Dietary groups		
	control	T1	T2
Performance index			
Day14	20.93	31.08	26.73
Day21	29.48	24.86	23.77
Day28	33.61	35.91	37.03
Day35	38.72	36.25	43.03
Day42	57.78	59.86	61.67
crude protein intake			
Day 14	22.66	22.43	22.25
Day21	26.11	25.82	25.65
Day28	32.60	32.83	33.12
Day35	37.84	37.95	38.12
Day42	119.20	119.03	119.14
protein efficiency ratio			
Day 14	1.51	2.19	1.86
Day21	1.36	1.03	0.98
Day28	1.13	1.15	1.24
Day35	1.04	0.91	1.09
Day42	1.22	1.24	1.25
Metabolizable energy intake			
Day 14	290.58	287.63	285.41
Day21	334.83	331.14	328.92
Day28	418.16	421.11	424.80
Day35	485.28	486.75	488.96
Day42	1528.84	1526.63	1528.10
Caloric conversion ratio			
Day 14	8.48	5.87	6.88
Day21	9.43	12.50	13.03
Day28	11.38	11.16	10.36
Day35	12.36	14.11	11.71
Day42	10.49	10.33	10.22

Control: basil Diet, T1: 4% potato chips scraps, T2: 8% potato chips scraps

3.1.6. Mortality rate

Our studies revealed that there were no found significant different in mortality rate in different groups compared with control group. These results are in accordance with those of Faddle[18] who recorded that throughout the experimental period, no birds died within all he different level of PCS levels to the experimental diets. Rahnema et al., [21] indicated that fed broiler chicks on diet contained PCS up to 7.5% up to 3 weeks of age can be of the diet safely. Agwunobi [22] demonstrated that mortality percentages did not affect by addition of either potato or sweet potato in diets.

Table 7: Effects of dietary inclusion with (potato chips scraps) on economic productivity of quails.

Items	Dietary groups			P- value
	control	T1	T2	
Chick price(LE)	1.75	1.75	1.75	-
FC(g/chick)	518±3.68	517±2.32	518±4.50	0.98
Feed price(LE)	10^{a}	9.86^{b}	9.72^{c}	0
BWG(g)	146±4.69	148±1.65	149±1.89	0.69
Total feed cost(LE)	5.18 ± 0.03^{a}	5.10 ± 0.02^{ab}	5.03 ± 0.04^{b}	0.04
Total cost(LE)	6.93 ± 0.03^{a}	6.85 ± 0.02^{ab}	6.78 ± 0.04^{b}	0.04
Total revenue(LE)	12	12	12	-
Net revenue(LE)	5.06 ± 0.03^{b}	5.14 ± 0.02^{ab}	5.21 ± 0.04^{a}	0.04
Economic efficiency	97.8 ± 1.40^{b}	101 ± 0.89^{ab}	104 ± 1.79^{a}	0.05
Relative economic efficiency	100 ± 0^{b}	103 ± 2.09^{ab}	106 ± 2.30^{a}	0.11

a,b,c,d Means within the same row with different letters are significantly different ($p \leq 0.05$). Control: basil Diet, T1: 4% potato chips scraps, T2: 8% potato chips scraps

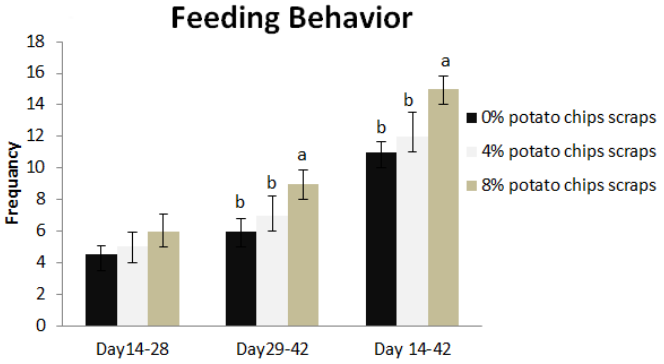

Figure 1: Effects of dietary inclusion with (potato chips scraps) on feeding behavior of quails.

Conclusion

It is concluded that incorporation of potato chips scraps to Japanese quail diets at level 4% and 8% had beneficial effects on growth performance, blood parameters, and behavior patterns resulted in improved economic efficiency during growing period of Japanese quails.

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