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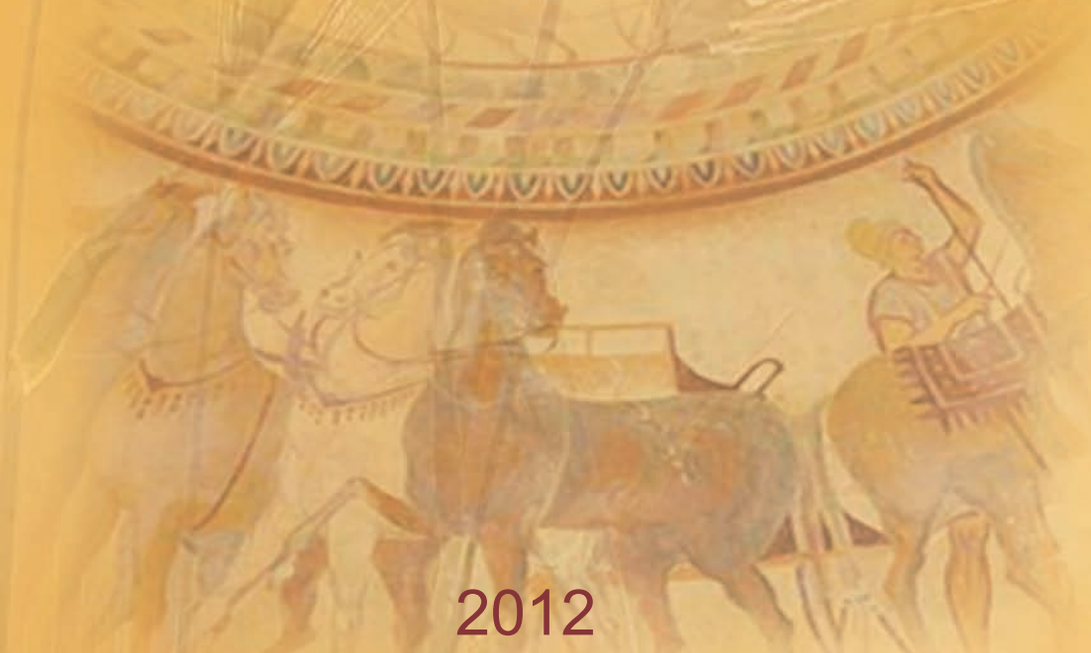

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Carcass traits, intestinal morphology and cooking yield of broilers fed different fermented soyabean meal based diets

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Abstract. *This study was conducted to compare the effects of different fermentation methods of soyabeans on carcass traits, intestinal morphology and cooking yield of broilers using 240 day-old Anak broilers that were allocated into 4 treatments of 3 replicates as thus: Soyabeans fermentation with lactobacillus as control group T1, Cooking and fermenting T2, Daddawa fermentation T3 and Cooking with potash before ferment T4 based groups. Five birds were selected from each group and fasted for 8 h prior to carcass evaluation. Live and plucked weights did not vary significantly (P>0.05) among processed broilers, significant (P<0.05) differences were recorded in the eviscerated weight. Other cut-up parts that vary significantly (P<0.05) include neck, breast, thighs, drumstick and back while head, wing and shank did not vary significantly (P>0.05). There were significant (P<0.05) variations in intestinal weight and organs like lungs, liver and gizzard, while heart, kidney, spleen and abdominal fat deposition showed no significant variation (P>0.05) between treatment. Variations in gastro-intestinal measurements did not follow any particular trend. Cooking yield was significantly (P<0.05) affected by treatment. Cook and ferment a simple solid state fermentation process has the potentials of producing best percentages of the fleshy parts, better meat/bone and cooking yield of broiler meat.*

Keywords: broilers, carcass traits, cooking yield, fermentation methods, organ morphology

Introduction

In spite of the limitations of soyabeans on account of cost and presence of some anti nutritional factors, many poultry producers depends on soyabean meal as the most commonly used source of supplementary protein for poultry because it is generally viewed as a consistent, high quality product (Britzman, 2006; Sarikhan et al., 2010; Ari et al., 2012). Considerable interest has recently been shown in the use of fermentation methods for the improvement of feeds and performance traits of poultry and other monogastric animals. Fermentation processes drastically reduces anti nutritional factors and also converts food compounds into structurally related but financially more viable food through the activities of microbial cells (Stanbury and Whitaker, 1984; Ayanwale and Ari, 2002; Barde and Ari, 2004). Fermentation of oilseeds and other feeds was observed to have remarkable influence on the morphology and bacterial ecology of their gastrointestinal tract (Canibe and Jensen, 2003; Canibe et al., 2008, Sarikhan et al., 2010).

The effects of feed treatments on meat yield and composition of broilers was also reported (Ayanwale et al., 2003) while the differences in carcass characteristics and organoleptic qualities were also reported to be affected by differences in feed nutrient utilization by broilers and monogastrics (Garcı´a, et al., 2007; Canibe et al., 2008; Sarikhan et al., 2010). The use of gut morphology measurements in the assessment of feed nutrients quality and anti-nutritional factors in broilers feeds have been reported (Ogbonna and Ige, 2002; Sun, 2004; Feng, 2007). Feed treatment effect was reported on some morphological measurements such as gizzard weight, liver weight, ceacum length and gut-gizzard length in broiler ration was reported by the same workers. This study was therefore conducted to investigate carcass traits, intestinal morphology and meat yield of broilers fed different fermented soyabean meal based diets.

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Material and methods

Soyabean collection, processing and diet preparation

Soyabeans seeds *(Glycine max)* were procured from a local market in Lafia metropolis of Nasarawa State, Nigeria. The collected seeds were cleaned by winnowing and hand picking of stones and debris. Equal quantities of the raw soyabeans were subjected to three uncontrolled (natural) fermentation processing methods viz: Cooking and fermenting (T2), Daddawa fermentation (T3) and Cooking with potash before fermentation (T4). Each of these processing methods serving as experimental treatment groups were compared with controlled fermentation (T1) process (Fermentation by culture organisms) which served as experimental control. The different fermentation processes are described as thus:

Fermentation by culture organisms (Lactobacillus bulgaricus, Saccharomyces cerevisiae and Sreptococcus lactis) – Treatment (1). The fermentation procedure was undertaken at the Animal Science Laboratory of the College of Agriculture, Lafia. The cleaned soyabean samples were tempered using the procedure described by Ari et al. (2012) before inoculation. The organisms used as starter culture were *Lactabocillus bulgaricus, Saccharomyces cerevisiae* and *Streptococcus lactis.* The tempered soyabean sample was inoculated using the procedure described by Pelczar et al. (1999) and adopted by Ari et al. *(*2012). The samples were sun dried and milled.

Cooking and fermenting – Treatment (2). The raw soyabeans were sorted to ensure homogeneous cleaned grains. Cleaned

soyabeans were cooked according to the methods described by Kaankuka *et al*. (1996) and fermented according to the method described by Ayanwale and Kolo (2002). The samples were sun dried and milled.

Daddawa fermentation – Treatment (3). The raw soyabeans seeds were briefly fried in a hot dry pan (common driers) for about 3 minutes. The fried beans were grinded to remove the skins and then boiled for 6 hours before fermenting as documented by Campbell – Platt (1980) and Water-Bayer (1988) as anindigenous innovation by Nigerian housewives in the fermentation of soyabeans into *daddawa* (local magi).

Cooking with potash before fermentation – Treatment (4). This method is a modification of the method described by Ayanwale and Kolo (2002). The raw soyabeans were cooked with 10 grams of potash / 100kg of soyabeans at 100°c for 15 minutes. The boiled grains were drained, cooled to room temperature and placed in a leaf-lined basket covered with further leaves and kept for 72 hours. The products were sun dried and milled.

Experimental treatment

A total of 240 days-old Anak broilers that were randomly divided into 4 experimental groups of three replicate each. Dietary treatments were as follows: T1, T2, T3 and T4 were representing lactobacillus as control fermentation, Cooking and fermenting, Daddawa and Cooking with potash before ferment based groups at both starter and finisher phases using Randomized Complete Block design, having the test ingredients incorporation as the main source of variation.

The starter diets were fed for 5 weeks (1 - 35 d) and the finisher diets were fed for 4 weeks (36 - 63 d). Experimental diets were formulated to have approximately 3,000 cal, 24% CP at starter stage and 3,100 cal, 22% at finisher level. The experimental feeds were formulated using at least cost feed formulation software *Feedwin.*

Carcass evaluation and gut morphology

A total of 5 birds were randomly selected from each of the replicate groups and fasted (no limitation of water access) for 8 h prior to complete carcass evaluation according to the methods described by Ayanwale (1999). The selected birds from each replicate group were weighed and each selected bird was slaughtered by cutting the jugular vein with a sharp knife. The weights of the slaughtered birds, dressed birds, eviscerated parts, cut up parts and organs were recorded and expressed as percentage of their respective plucked weights. The gut morphology of the processed birds were obtained by weighing and measurements of organs and the gastro intestinal tract according to the methods described by Ogbonna and Ige (2002).

Meat to bone ratio

The determination of the meat to bone ratio was conducted after other carcass parameters have been measured in the process of carcass evaluation. The bones of the birds were manually separated from the meat. The weights of the meat and the bones then were determined. The ratio of meat to bone was calculated as: meat bone ratio = weight of meat/weight of bone.

Cooking losses and yields

The total cooking losses were determined by pre and post-weight measurement during heat processing according to the method described by Awonorin and Ayoade (1992) and adopted by Aya (2003).

Chemical analysis

Chemical composition of each of the fermented soyabeans samples and experimental diets were determined following standard methods (AOAC, 1995).

Statistics

Data collected were subjected to one-way analysis of variance (ANOVA), Means were separated where there were significant differences using Duncan's Multiple Range Test (Duncan, 1955) using SPSS 16.0.

Results

The effect of fermentation methods on the carcass characteristics of the experimental birds are presented in Table 2. While the live weight and plucked weight percentage did not vary significantly ($P>0.05$) among processed broilers, significant ($P<0.05$) differences were recorded in the eviscerated weight of fermentation treatment groups. Other cut-up parts that vary significantly ($P<0.05$) include; neck, breast, thighs, drumstick and back. No significantly ($P>0.05$) differences were however observed between the mean values for head, wing and shank. The best percentages for the fleshy parts and the meat/bone ratio were 9.34% of breast in cook and ferment, 4.64% of thighs and 3.89% of drumstick in cook with potash and ferment and 2.19 ratio of meat to bone in daddawa.

The morphology of internal organs of experimental broilers fed diets is presented as measured parameters in Table 3. There were significant ($P<0.05$) variations in intestinal weight and organs like lungs, liver and gizzard while heart, kidney spleen and abdominal fat deposition did no vary ($P>0.05$) significantly between treatment groups.Gastro-intestinal measurements indicated no significant ($P>0.05$) differences between treatment groups in the following parameters; proventiculus, ceacum length and width small intestine and colo-reticulum while duodenum fold length, duodenum width, jejuum width, ileum length, colo-recticulum length and colo-gizzard varied significantly ($P<0.05$) between treatments. Daddawa recorded the highest and lowest duodenum fold length and duodenum width (17.67 and 1.50 cm) respectively among treatments. Similarly ceacum length and width were lowest and highest (21.00 and 6.67 cm) respectively among treatments.

Cooking yield presented in table 4 was significantly ($P<0.05$) reduced in the cook with potash and ferment group (60.25%) when compared to cook and ferment with 64.77% being the highest value. Cook with potash and ferment also significantly ($P<0.05$) increased the level of meat cooking loss (39.75%) as the highest loss recorded among treatments.

Discussion

The observed differences in carcass characteristics were as a result of differences in the fermentation methods of the test ingredient which resulted in the differences in their nutrient mobilization for meat formation which may have more bearings on the differences in fermentation microbes' activities than anti-nutritional factors. The low abdominal fat deposition recorded in all

Table 1. Composition and analyses of fermented soybean based of experimental diets

Ingredients	Starter phase				Finisher phase			
	T1	T2	T3	T4	T1	T2	T3	T4
Maize	32.75	38.3	37.5	38.25	36	41.5	41.5	41.5
Maize Bran	13	8	10.25	10.25	13	9	11.25	11.5
Rice Bran	5	2.5	2.85	2.55	5	1.25	2.25	2.5
Soya lactobacillus	29.35	-	-	-	29.35	-	-	-
Soya Cook & ferment	-	32	-	-	-	31.5	-	-
Soya daddawa	-	-	31	-	-	-	30.25	-
Soya ferment + K	-	-	-	29.5	-	-	-	30
Blood Meal	3.75	5	4.25	4.75	2	3.5	2.25	2.25
Fish Meal	4	4.75	4	4.25	3.25	3.8	3.3	3.3
Bone Meal	4	4	3.5	3.5	4	3.5	3.5	3.25
Limestone	4.7	0.5	1.7	1	3.2	-	-	-
Palm Oil	0.5	2	2	3	1.25	3	2.75	2.75
L-Lysine	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
DL-Methionine	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Salt	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100
Calculated analysis	3000.93	3000.22	3014.23	3008.08	3093.93	3083.07	3115.02	3028.85
ME/Kcal/kg	24.01	24	24.01	24.08	22.05	21.98	21.92	21.82
CP%								
Determined analysis	90.47	92.78	91.4	92.05	92.93	92.43	94.19	92.57
Dry Matter (%)	22.91	22.3	22.47	20.13	21.23	21.66	21.06	23.24
Crude Protein (%)	6.78	6.06	6.74	6.82	5.67	6.9	6.93	5.91
Crude Fibre (%)	9.88	12.01	13.5	9.48	11.5	11.23	13.3	11.53
Ether extract (%)	12.79	17.25	17.76	17.21	15.03	12.11	8.76	11.19

*Premix to provide the following per kg of diet: Vitamin A, 9,000 IU; Vitamin D3, 2,000,IU; vitamin E, 18 IU; vitamin B1, 1.8 mg; vitamin B2, 6.6 mg B2,; vitamin B3, 10 mg; vitamin B5, 30 mg; vitaminB6, 3.0 mg; vitamin B9, 1 mg; vitamin

Table 2: Effect of different fermentation methods of soyabeans on carcass characteristics of broilers

Parameters	Fermentation methods				SEM
	T1	T2	T3	T4	
Live Weight (g)	2776.00	2833.00	2833.40	2500.00	7.69^{ns}
Pluck Weight (g)	262.30	267.03	271.00	228.30	7.56^{ns}
Pluck Percentage (g)	94.43	94.25	95.72	91.61	0.84^{ns}
Eviscerated Weight (g)	165.67^{b}	209.00^{a}	213.33^{a}	171.67^{b}	7.26*
Head (%)	0.81	0.90	0.85	0.86	0.02^{ns}
Neck (%)	1.38^{b}	2.03^{a}	1.44^{b}	1.50^{b}	0.08*
Wing (%)	2.87^{b}	2.99^{ab}	2.67^{b}	3.37^{a}	0.09*
Breast (%)	7.04^{c}	9.34^{a}	8.81^{ab}	8.41^{b}	0.29*
Thighs (%)	3.47^{c}	4.46^{ab}	4.20^{b}	4.64^{a}	0.14*
Drumstick (%)	3.30^{b}	3.56^{ab}	3.29^{b}	3.82^{a}	0.08*
Back (%)	3.47^{b}	3.47^{b}	4.97^{a}	3.86^{b}	0.19*
Shank (%)	1.26^{ab}	1.34^{a}	1.04^{b}	1.44^{a}	0.06*
Meat/Bone Ratio	3.48^{a}	2.87^{ab}	2.19^{b}	3.15^{a}	0.18*

a b c - Means in the same column with the same superscript are not significantly (P>0.05) different SEM Pooled standard error of means, * Significantly (P<0.05) different, ns - not significant, % Percentages are with respect to plucked weight.

Table 3: Effects of different fermentation methods of soyabeans on organs morphology of broilers

Parameters	Fermentation methods				SEM
	T1	T2	T3	T4	
Intestine (g)	1.64[a]	1.67[a]	1.39[b]	0.86[c]	0.10*
Lungs (g)	0.14	0.20	0.13	0.20	0.02[ns]
Liver (g)	0.78[a]	0.66[b]	0.53[c]	0.66[b]	0.03*
Hearts (g)	0.20	0.23	0.08	0.22	0.03[ns]
Kidney (g)	0.03	0.13	0.03	0.03	0.03[ns]
Spleen (g)	0.04	0.14	0.02	0.03	0.03[ns]
Gizzard (g)	1.13[a]	0.92[ab]	0.62[b]	0.79[b]	0.67*
Gall Bladder (g)	0.04	0.13	0.01	0.10	0.03[ns]
Abdominal Fat (g)	0.39	0.41	0.15	0.44	0.04[ns]
Crop Oesophagus (g)	12.30[a]	7.83[d]	10.67[b]	9.43[c]	0.51*
Proventiculus (g)	0.50	0.50	0.23	0.45	0.07[ns]
Duodenum Fold Length (cm)	14.50[b]	16.00[b]	17.67[a]	16.00[b]	2.13*
Duodenum Width (cm)	2.97[a]	2.92[a]	1.50[b]	2.68[a]	0.20*
Jejunum Width (cm)	2.57[a]	2.15[ab]	1.68[b]	2.04[ab]	0.12*
Ileum Length (cm)	2.11[a]	1.90[ab]	1.08[c]	1.68[b]	0.12*
Ceacum Length (cm)	23.17	26.17	21.00	24.00	0.90[ns]
Ceacum Width (cm)	3.83	3.33	6.67	3.33	1.01[ns]
Small Intestine (cm)	70.00	86.67	66.67	70.00	4.14[ns]
Colo-Recticulum Length (cm)	12.43	13.00	16.00	12.50	0.61[ns]
Colo-Recticulum Width (cm)	2.70[a]	1.57[b]	2.90[a]	2.07[ab]	0.21*
Colo-Gizzard Length (cm)	25.10[a]	24.33[ab]	19.83[c]	20.53[bc]	0.82*

abc - Means in the same column with the same superscript are not significantly (P>0.05) different SEM -Pooled standard error of means ; * Significantly (P<0.05) different; ns - not significant

the fermentation groups indicated the potentials of feeding broilers with fermented products as a means of regulating abdominal fat deposition. Ayanwale and Kolo (2002) as well as Kalavathy et al. (2003) also reported reduction in the abdominal fat deposition of broilers fed fermented products.

Changes observed in some gut measurements and organ weights in response to dietary treatments were similar to the observation of Sun (2004), similar observation on the effect of feed treatment on organ weights was reported by Zhou et al. (2009) and Yang et al. (2010). The general reduction in size, length and width of intestinal organs can be attributed to reduced nutrient competition in the intestine between the host birds and pathogenic microorganisms that are displaced by beneficial fermentation microbes leading to reduced local inflammation and improved digestion as reported by Apajalahti et al. (2004) and Garcı´a, et al. (2007).

The observed differences in some intestinal size recorded among treatments can be accounted for by the modulatory effects of the gastro intestinal tracts (GIT) and nature of microorganism associated with each treatment inhabiting the gastro intestinal tract linings as well as transit time of feed in the GIT as earlier reported (Williams et al., 2001). A relationship between the protein quality of the test ingredients and the removal anti nutritional factors (Table 5) with some GIT size can be established as daddawa gave the best values for phytic acid removal (113.90 mg/100g) as against 345 mg/100g in raw soyabeans and had one of the best protein qualities with protein solubility index (PSI) of 84.81% as compared to 84.85 and 85.74% in controlled fermentation and raw soyabeans (Ari et al., 2012).This might accounted for lower transit time of daddawa based

Table 4: Means sensory values of cooking yield and cooking loss of broilers fed different fermented soyabeans based diets (%)

Parameters	Fermentation methods				SEM
	T1	T2	T3	T4	
Cooking yield	63.25[a]	64.77[a]	63.57[a]	60.25[b]	± 0.62*
Cooking Loss	36.75[a]	35.23[a]	36.43[a]	39.75[b]	± 0.62*

a b c - Means in the same column with the same superscript are not significantly (P>0.05) different
SEM Pooled standard error of means ; * Significantly (P<0.05) different

Table 5: Effect of fermentation on the value of anti-nutritional factors and protein quality of Soyabeans

Parameters	Raw soya	Lactobacillus	Cook & ferment	Daddawa	Cook + potash & ferment
Trypsin Inhibitor Activity TIA (mg/k)	15.35	Trace	Trace	Trace	Trace
Reduction in TIA (%)	0.00	100	100	100	100
Phytic Acid (mg/100g)	345.00	126.98	276.60	113.90	146.40
Reduction in PA (%)	0.00	63.19	19.83	66.99	57.57
Urease Assay (∆pH)	0.03	0.06	0.18	0.04	0.16
Protein Solubility Index PSI (%)	85.74	84.85	78.12	84.81	75.43

Source: Ari et al. (2012)

diets on GIT and thus modifying duodenum length and other modulated GIT organs.

Conclusion

The findings of this work suggest that simple solid state fermentation like cook and fermentation has the potentials of producing best percentages of the fleshy parts, better meat/bone and cooking yield of broiler meat, while daddawa presented a more effective GIT morphology by measurements.

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The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods,Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

Names and affiliation of authors

The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors are designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *.

Abstract should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

Keywords: Up to maximum of 5 keywords should be selected not repeating the title but giving the essence of study.

The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal ?

Material and methods: The objects of research, organization of experiments, chemical analyses, statistical and other methods and conditions applied for the experiments should be described in detail. A criterion of sufficient information is to be possible for others to repeat the experiment in order to verify results.

Results are presented in understandable tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text. **Tables** should be as simple and as few as possible. Each table should have its own explanatory title and to be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

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Discussion: The objective of this section is to indicate the scientific significance of the study. By comparing the results and conclusions of other scientists the contribution of the study for expanding or modifying existing knowledge is pointed out clearly and convincingly to the reader.

Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn't be numbered and no new paragraphs be used. Contributions are the core of conclusions.

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Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows,IXth International Conference on Production Diseases in Farm Animals, Sept.11 – 14, Berlin, Germany, p. 302 (Abstr.).

Thesis:

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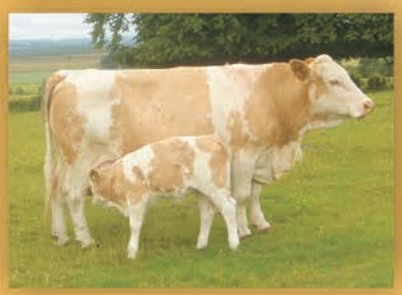

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