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Abstract

The study was conducted to determine the growth performance and carcass traits of Cobb® Broiler broilers supplemented with different preparations of butterfly pea (*Clitoria ternatea*) at varying inclusion frequencies. The study used the 3x2 factorial in Completely Randomized Design, with the type of butterfly pea preparation as factor A (A1 – Control Group, A2 – butterfly pea flower (BPF) as fermented juice, and A3 – BPF decoction, both supplemented in drinking water (10%), whereas factor B was the frequency of supplementation (B1 – every day, B2 – every other day). Day-old Cobb broiler chicks with similar average weight of 50–60 grams were randomly distributed to six groups, which had three replicates each, and seven birds per replicate, for a total of 126 birds. The body weight, average weight gain, and feed conversion ratio revealed there was no interaction effect for the two factors, but there were highly significant differences among the control and BPF preparations, and between the two frequencies of supplementation. Butterfly pea flower-treated groups had better results than the control, with BPF-fermented juice (A2) having the best results, followed by BPF-decoction (A3). Between the frequencies, it was everyday supplementation (B1) that showed better performance values. No significant differences were observed on carcass traits including dressed weight, carcass percentage, and relative organ weights (liver, spleen, gizzard, and heart).

Keywords: *broiler, butterfly pea, chicken, ternatea*

Introduction

Chicken production continues to be one of the largest contributors to the animal industry in the Philippines, with positive growth rate in the last three years (2022–2024). With a total of 2.08 metric tons of chicken production in 2024, the great majority of 85.6% share belongs to broiler type, which are mostly from commercial farms. Bulacan province had the highest production in 2024, with 197.57 thousand metric tons of live weight (PSA, 2025).

Despite this reported growth and stability of the chicken industry, chicken farmers still face problems on reduced profits due to feed cost, low growth performance compared to neighboring countries, and market factors, among others. The Philippine government passed the Philippine Organic Agriculture Act of 2010, also known as Republic Act 10068, which provides guidelines that strengthen and encourage

livestock and poultry farmers to produce more organic products that are readily available in the community. Thus, the use of ethnoveterinary products has become more widespread in rural communities, but these are often not backed up by published research. The results on promising ethnoveterinary products may benefit both small-hold and commercial poultry farms, as well as the chicken-loving households and communities.

There is a great wealth of plant materials available in the Philippines that can be tapped to improve the performance and productivity of farmed animals. One of these is the butterfly pea or blue pea (*Clitoria ternatea*), a leguminous tree with solitary flowers of vibrant blue and white color that has medicinal and agricultural uses. In this study, the butterfly pea flower was made into fermented plant juice and decoction, and was tested on its effect on the growth performance and carcass traits of broiler chicken at varying inclusion frequencies.

Objectives of the Study

The general objective of this research was to evaluate the response of performance and carcass traits of broiler chicken supplemented with different preparations of butterfly pea (*Clitoria ternatea*) at varying inclusion frequencies.

Specifically, it sought to: (1) determine the effect of butterfly pea preparation on the performance traits of broiler chicken in terms of body weight (BW), feed conversion ratio (FCR), and average daily gain (ADG); and (2) to assess the effect on carcass traits including dressed weight, dressing percentage, and relative organ weights (liver, spleen, gizzard and heart).

Materials and Methods

Experimental Design and Layout

This institutionally-approved research followed the 3x2 factorial in a completely randomized design. The six groups were replicated thrice, with seven birds per replicate, for a total of 126 chickens. The study tested two factors, namely: the treatments and the frequency. The experimental treatments for Factor A (treatments): A1 – Control Group, or pure drinking water; A2 – butterfly pea flower fermented juice (10%) in drinking water; and A3 – butterfly pea flower decoction (10% in drinking water); and for Factor B (Frequency of administration): B1 – every day, B2 – every other day. The experimental lay-out was generated using *Statistical Tool for Agricultural Research* (STAR).

Experimental Animals

The study used only Class A, or premium quality, day-old Cobb broiler chicks with similar average weight of 50–60 grams. They were purchased from Poultrymax Omnis, Inc., located at Binayuyo St., Catmon, Santa Maria, Bulacan. The chicks were vaccinated with Newcastle disease vaccine B1B1 strain before dispatch from the hatchery. A total of 126 chicks with relatively uniform weight were divided into 18 groups or 7 chicks per replicate.

Different Preparations of Butterfly Pea

The butterfly pea flower preparations were made daily to ensure freshness. In preparing the butterfly pea flower fermented juice (BPF-FJ) concoction, 1 kg butterfly pea flower was chopped into small pieces and incorporated with 1 kg molasses. These were mixed thoroughly, then stored in a clean pail which was covered and sealed for 7 days. The juice was collected, and mixed with clean drinking water at a ratio of 100 mL BPF-FJ per 900 mL water.

The second treatment used butterfly pea flower decoction (BPF-D), which was obtained by sun drying, then boiling every 5 g dried flowers in 250 mL of water for five minutes. The flowers were pressed

gently during boiling in order to obtain more extract. The boiled extract was strained to remove all solid matter. To prepare 10% solution, each 100 mL of extract was added with 900 mL water.

In this research, the cultivars or variety of butterfly pea flower were not subjected to proper identification by experts, but the single flower type of dark blue color was used. Only mature flowers or those that have fully bloomed were collected and used in the making of decoction and fermented juice.

Housing and Brooding Management

The housing has a deep litter type of flooring, composed of concrete covered with rice hull and sawdust, and with the whole area divided into 18 compartments, each with seven birds. The space allocation was at least 1 sq ft per bird to meet the national standards. Each compartment that houses seven birds had an area of 7.1–7.3 sq ft, which was maintained from brooding until harvest. Big clumps on the litter flooring, caused by excess moisture and dirt, were removed regularly to maintain a dry and clean environment for the chickens.

An hour before stocking with the day-old chicks, installed light bulbs were turned on. When the chicks arrived, the researcher provided water with dextrose powder. Chick booster mash was sprinkled on the newspaper matting. An environmental temperature of 31–33°C was maintained during brooding with the help of a room thermometer, and to ensure that the chicks were comfortable, their behavior was observed. On the second week, an environmental temperature of 29–30°C was maintained, and starting the third week until harvest, the temperature was lowered to 26–28°C. The canvas used as curtain was raised in certain portions daily to improve the ventilation in the housing and humidity, although there was no instrument used to measure the relative humidity during the study.

Feeding Management

Ad libitum feeding management using commercial feeds was done all throughout the experiment. Chick booster mash was given during the first two weeks. Starting the third week, the birds were fed with broiler starter crumbles. Shifting from one class of feed to another was done gradually. Plastic bell-shaped feeders and waterers with capacity of two liters were used, both were allocated to each group of seven birds. Supplementation with fresh preparations of butterfly pea flower started on day 8 right after brooding. Instead of the usual drinking water, the butterfly pea flower–fermented juice and decoction were put in the waterers of experimental birds, either daily or every other day depending on their group. The butterfly pea flower–fermented juice (BPF-FJ) and decoction (BPF-D) were both accepted by the birds, with no changes on their usual water consumption compared to the previous days.

The daily water consumption of every group of seven birds ranged from about 500 mL in the first week, up to 2 L in the fifth week. The contents of 2 L-capacity waterers were not totally consumed by the birds until about the last 3–5 days of study, so by this time the containers were replenished with up to 250 mL in the afternoon.

Table 1

Guaranteed Feed Analysis of Chicken Feeds Used in the Study, as Provided by the Manufacturer

Nutrient	Booster	Starter
Crude Protein	21.50%	19.50%
Fiber	5.00%	Max. 6.00%
Fat	3.00%	Min. 3.00%
Calcium	0.90–1.10%	0.90% - 1.10%
Phosphorus	Min. 0.55%	Min. 0.55%
Moisture	Max. 12.00%	Max. 12.00%

Weighing

The experimental animals were weighed individually using a digital weighing scale of up to 0.01 gram precision on the 7th, 14th, 21st, 28th and 35th day.

Slaughtering and Carcass Evaluation

A total of 54 heads (3 heads per replicate) were selected for slaughter on day 35. These were fasted for 12 hours before slaughter. Prior to the slaughter process, the chickens were individually weighed again to determine their final live weight to be used in the carcass percentage computation. The research followed proper animal handling practices as well as the necessary steps in slaughtering the chickens, with supervision by licensed veterinarian. Following the slaughter, the carcasses were evaluated to assess the yield and characteristics. Weights of carcass was recorded, and the dressing percentage was calculated as carcass weight divided by live body weight. The weights of the edible visceral organs (liver, spleen, gizzard, heart) were also recorded and calculated as percentage of carcass weight.

Data Gathered

The following data were gathered: 1.) Performance - a) *body weight* – live weight of birds at day 7, 14, 21, 28 and 35; b) *average daily gain* – (final wt - initial weight) / (number of days); c) *Feed Conversion Ratio (FCR)* – (feed given) / (weight gain); and d) *mortality* – number of deaths; 2.) Carcass traits - a) *carcass weight*; b) *carcass percentage* – (dressed weight) / (live weight); and d) *relative organ weights* – wt of specific organ / dressed wt.

Statistical Analysis

The Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) was used to analyze the performance and carcass trait data, with the Statistical Tool for Agricultural Research (STAR) software. The mean differences were evaluated using Least Significant Differences (LSD) at 5% level.

Results and Discussion

Production Performance

Body Weight

The birds were given *ad libitum* commercial feeds. The butterfly pea preparations were introduced on day 8 and lasted until harvest. The daily water consumption of every group of seven birds ranged from about 500 mL in the first week, up to 2 L in the fifth week, and with no differences in the water consumption between control and experimental groups. The results on body weight are shown in Table 2. In summary, there were no interaction effects observed between the water supplementation and frequency from day 7 up to day 35. The type of water supplementation started to show significant effect from day 14, and this was maintained up to day 35. The frequency had a significant effect only on day 35, the last day of weighing.

On day 7, the mean body weight of chickens ranged from 253.67 g to 277 g in the six treatment groups. There was no significant difference among the different preparations of butterfly pea flower (Factor A), the frequencies of supplementation (Factor B). The results indicate that the birds were relatively similar in size and weight at the beginning of the experiment.

On day 14, the achieved body weight among the six groups ranged from 593.33 (A1B1 – control) to 666.67 g (A2B1 – BPF-FJ, everyday). Interestingly, the groups that received butterfly pea flower (BPF) supplementation showed significantly higher (p = .02) body weight compared to the control. The obtained mean in A3 (BPF-decoction) was 653.33 g, and in A2 (BPF-fermented juice) was 650 g, while it was

606.67 g in A1 (control). The frequency of supplementation had no significant effect on the body weight in this stage of production.

On day 21, the achieved body weight among the six groups ranged from 846.67 (A1B1, A1B2 – control) to 1,003.33 g (A2B2 – BPF-FJ, every other day). The supplementation had significant effect (p = .03), wherein chickens in A2 (BPF-FJ) obtained a mean body weight of 975 g, which was significantly different to A1 (control) with a mean of 846.67 g, but comparable to A3 (BPF-D) with a mean of 916.67 g. There was also no significant effect observed from the frequency of supplementation.

On day 28, the achieved body weight among the six groups ranged from 1,173.33 g (A1B1 – control) to 1,976.67 g (A2B1-BPF-FJ, everyday). The supplementation had significant effect (p = .02), wherein the body weight of chickens in A2 (BPF-FJ) still obtained a significantly different to A1 (control) but comparable to A3 (BPF-D). The mean for A2 was 1,450 g, which was different to A1's mean 1,243.33 g, but comparable to A3's 1,370 g. As with the previous weeks, there was also no significant effect from the frequency of BPF supplementation.

Table 2

Body Weight (grams) of Cobb® Broiler as Supplemented with Different Preparations of Butterfly Pea (Clitoria ternatea) at Varying Inclusion Frequencies

Age of Bird	Factor A - Treatment	Factor B - Frequency B1 (Every Day)	Factor B - Frequency B2 (Every Other Day)	Mean (Factor A)	p Value (Factor A)
Day 7	A1 (Control)	253.67	267.33	260.50	
	A2 (BPF-FJ)	272.00	264.33	268.17	.06
	A3 (BPF-D)	268.00	277.00	272.50	
	Mean (Factor B)	264.56	269.55		
	p Value (Factor B)	.21		p (combined) = .09	
Day 14	A1 (Control)	593.33	620.00	606.67_{b}	
	A2 (BPF-FJ)	666.67	633.33	650.00_{a}	0.02
	A3 (BPF-D)	650.00	656.67	653.33_{a}	
	Mean (Factor B)	636.67	636.67		
	p Value (Factor B)	1.00		p (combined) = .19	
Day 21	A1 (Control)	846.67	846.67	846.67_{b}	
	A2 (BPF-FJ)	946.67	1003.33	975.00_{a}	.03
	A3 (BPF-D)	900.00	933.33	916.67_{ab}	
	Mean (Factor B)	897.78	927.76		
	p Value (Factor B)	.41		p (combined) = .80	
Day 28	A1 (Control)	1173.33	1313.33	1243.33_{b}	
	A2 (BPF-FJ)	1456.67	1443.33	1450.00_{a}	.02
	A3 (BPF-D)	1336.67	1403.33	1370.00_{ab}	
	Mean (Factor B)	1322.22	1386.66		
	p Value (Factor B)	.23		p (combined) = .50	
Day 35	A1 (Control)	1813.33	1643.33	1728.33_{c}	
	A2 (BPF-FJ)	1976.67	1920.00	1948.33_{a}	.00
	A3 (BPF-D)	1856.67	1750.00	1803.33_{b}	
	Mean (Factor B)	1882.22_{a}	1771.11_{b}		
	p Value (Factor B)	.00		p (combined) = .15	

Note: In a row or column, means followed by different letter subscripts are significantly different at 5% level.

Finally, on day 35, the achieved body weight among the six groups ranged from 1,643.33 g (A1B1 – control) to 666.67 g (A2B1 – BPF-FJ, everyday). The supplementation had highly significant effect (p =

.00), wherein A2 (BPF-FJ) was highly significantly different to A3 (BPF-D) and A1 (control). The obtained mean body weight for these groups were 1,948.33 g, 1,803.33 g, and 1,728.33 g for A2, A3 and A1, respectively. Moreover, for the first time, the frequency had highly significant effect (p = .00) at day 35, whereas B1 (every day) with a mean of 1,882.22 g was significantly different at 1% to B2 (every other day) with a mean of 1,771.11 g.

The obtained live weight of the broiler chickens is within the range of market weight in the country, specifically on the 28th and 35th day of production, similar to published researches on broiler in the Philippines (Manuel, 2015; Nicolas, 2017; Plaza, 2017). The results revealed that supplementation with butterfly pea flower improved the body weight of broilers, with better effects from fermented juice compared to decoction. These results concur with the studies of Sapsuha et al. (2023) wherein butterfly pea flower extract supplementation had significantly higher bodyweight compared to unsupplemented chickens in Indonesia. There is limited research to explain the effect of butterfly pea flower (BPF) extract on increasing the weight of broiler chickens, but could be due to improved physiological or metabolic conditions from the beneficial effects of flavonoids, phenols and other phytochemicals in BPF. Published studies on beneficial effects of BPF in humans and animals include anti-oxidant, anti-inflammatory, anti-microbial, and anti-parasitic effects (Gomez & Kalamani, 2003; Muhammad Ezzudin & Rabeta, 2018; Putri et al., 2023).

ADG and FCR

The average daily gain (ADG) is the quotient of the total gain in weight of birds and the number of days of production. Table 3 shows the ADG of the chickens throughout the 35 days production period. Among the different preparations of butterfly pea (*Clitoria ternatea*), the overall highest ADG was in A2 (BPF-FJ) with 1,938.40 g mean ADG, followed by A3 (BPF-D) with 1,793.24 g, and the lowest was in A1 (control group) with 1,718.69 g. On the other hand, the mean for B1 (every day supplementation) was 1872.42 g, and for B2 (every other day) was 1,761.13 g.

Table 3

Average Gain in Weight (Grams) and Feed Conversion Ratio of Cobb® Broiler as Supplemented with Different Preparations of Butterfly Pea (Clitoria ternatea) at Varying Inclusion Frequencies

	Factor A - Treatment	Factor B - Frequency B1 (Every Day)	Factor B - Frequency B2 (Every Other Day)	Mean (Factor A)	p Value (Factor A)
Average daily gain (grams)	A1 (Control)	1803.94	1633.43	1718.69_c	
	A2 (BPF-FJ)	1966.59	1910.21	1938.40_a	0.00
	A3 (BPF-D)	1846.74	1739.74	1793.24_b	
	Mean (Factor B)	1872.42_a	1761.13_b		
	p Value (Factor B)	0.00		p (combined) = .15	
Feed conversion ratio	A1 (Control)	1.85	1.90	1.87_b	
	A2 (BPF-FJ)	1.54	1.70	1.62_a	0.03
	A3 (BPF-D)	1.68	1.69	1.68_{ab}	
	Mean (Factor B)	1.69	1.76		
	p Value (Factor B)	0.32		p (combined) = .69	

Note: In a row or column, means followed by different letter subscripts are significantly different at 5% level.

Analysis of variance showed there was no interaction effect for the type and frequency of supplementation, but both the type and frequency of BPF supplement had highly significant effect (p = .00) on ADG, where A2 was significantly different to A3 and A1, while B1 (every day) was highly significantly different to B2 (every other day).

The feed conversion ratio (FCR) or feed efficiency is the amount of feed consumed per kilogram increase in body weight, and lower FCR means better efficiency. The results on the FCR throughout the five weeks production period are shown in the third row of Table 3. Similar to ADG, these results on feed conversion efficiency revealed no interaction effect, and that supplementation with butterfly pea - fermented juice (10%) in drinking water and butterfly pea flower-decoction (10%) in drinking water improved the FCR of broilers. The overall best FCR was in A2 (BPF-FJ) with mean of 1.62, which was comparable to those supplemented with A3 (BPF-D) with mean FCR of 1.68. The control group (A1) had a mean FCR of 1.87. Interestingly, unlike the results for ADG, the results for FCR had no significant difference between the frequencies of supplementation. Daily supplementation (B1) had a mean of 1.69 which was comparable to alternate day supplementation (B2) with 1.76 computed FCR.

These results on ADG and FCR likewise agree with that of Sapsuha et al*.* (2023), wherein butterfly pea flower extract significantly improved the average daily gain and feed conversion ratio of broilers. These results further illustrate that BPF has good effects on chicken's growth performance, supporting the purported anti-oxidant and other beneficial effects of anthocyanins (Vidana Gamage et al*.,* 2021) and other phytochemicals in BPF (Afrianto et al., 2020). The findings are consistent with other studies that reported enhanced ADG and FCR in chickens supplemented with herbal preparations in the drinking water (Manuel, 2015; Huervana, 2016; Haniarti et al., 2019).

Mortality Data

Table 4 shows the mortality rate on broiler affected by different preparations of butterfly pea (*Clitoria ternatea*) at varying inclusion frequencies. Mortality cases were observed in the first two weeks of production. The obtained average mortality rate for Treatment A1 was 1.17%, while Treatment A2 had 0.67% and Treatment A3 had 0.50%. Out of 126 experimental birds, a total of 14 were counted as mortality, majority (10) of them occurring on the first week. ANOVA revealed that different mixtures did not significantly affect the mortality rate of the Cobb® broiler.

Table 4

Mortality (%) of Cobb® Broiler as Supplemented with Different Preparations of Butterfly Pea (Clitoria ternatea) at Varying Inclusion Frequencies

Factor A - Treatment	Factor B - Frequency		
	B1	B2	Mean
A1 (Control)	1.66	0.67	1.17
A2 (BPF-FJ)	0.67	0.67	0.67
A3 (BPF-D)	0.33	0.67	0.50
Mean	0.89	0.67	

The first week of a chicken's life is the most critical, with the highest cases of mortality compared to other weeks of production stage, partly due to immature digestive and immune systems in the body (Ravindran & Abdollahi, 2021) and inadequate body heat regulation (Fairchild, 2012). The current study was conducted in December to January, the coldest months in the Philippines. First-week mortality was shown to be significantly related to many factors in the breeder farm, hatchery, and brooder house (Yassin et al*.,* 2009). The mortality cases were not subjected to necropsy to properly diagnose the causes of death.

Although there were no statistically significant differences, the lower number of mortality cases in the experimental groups compared to the control may still support the purported medicinal benefits of butterfly pea flower (Gomez & Kalamani, 2003; Muhammad Ezzudin & Rabeta, 2018).

Carcass Traits of Broilers

The results on carcass traits are shown in Table 5, including the carcass weight, carcass percentage, and relative percentage of organ weights (liver, spleen, gizzard, heart) to dressed weight.

The dressed weight of chickens include the weight of the whole carcass when the head, feet, and internal organs of chickens are removed. The highest carcass weight among the treatments was A2 (BPF-FJ) with 1,336.67 g, which was significantly different from A3 (BPF-D) and A1 (control) with dressed weight of 1,190.00 g and 1,135 g, respectively. In terms of frequency of supplementation, B1 (everyday) had the higher dressed weight with 1,276.67 g, compared to B2 (every other day) with 1,164.44 g. Analysis of variance revealed that there were highly significant differences among types of treatments and frequencies (p = .00).

Table 5

Carcass Traits of Cobb® Broiler as Supplemented with Different Preparations of Butterfly Pea *(Clitoria ternatea*) at Varying Inclusion Frequencies

	Factor A - Treatment	Factor B - Frequency B1 (Every Day)	Factor B - Frequency B2 (Every Other Day)	Mean	p Value (Factor A)
Dressed weight (grams)	A1 (Control)	1196.67	1073.33	1135.00_b	
	A2 (BPF-FJ)	1383.33	1290.00	1336.67_a	0.00
	A3 (BPF-D)	1250.00	1130.00	1190.00_b	
	Mean	1276.67_a	1164.44_b		
	p Value (Factor B)	0.00			p (combined) = .93
Carcass percentage (%) = dressed wt./live wt.	A1 (Control)	65.99	65.29	65.64	
	A2 (BPF-FJ)	69.94	67.19	68.57	
	A3 (BPF-D)	67.32	64.49	65.91	
	Mean	67.75	65.66		
Liver percentage (%) = liver wt./dressed wt.	A1 (Control)	0.11	0.12	0.12	
	A2 (BPF-FJ)	0.11	0.11	0.11	
	A3 (BPF-D)	0.12	0.11	0.12	
	Mean	0.11	0.11		
Spleen percentage (%) = spleen wt./dressed wt.	A1 (Control)	0.02	0.01	0.02	
	A2 (BPF-FJ)	0.01	0.01	0.01	
	A3 (BPF-D)	0.02	0.01	0.02	
	Mean	0.02	0.01		
Gizzard percentage (%) = gizzard wt./dressed wt.	A1 (Control)	0.09	0.08	0.09	
	A2 (BPF-FJ)	0.07	0.08	0.08	
	A3 (BPF-D)	0.09	0.08	0.09	
	Mean	0.08	0.08		
Heart percentage (%) = heart wt./dressed wt.	A1 (Control)	0.02	0.02	0.02	
	A2 (BPF-FJ)	0.02	0.02	0.02	
	A3 (BPF-D)	0.02	0.03	0.02	
	Mean	0.02	0.02		

Note: In a row or column, means followed by different letter subscripts are highly significantly different at 5% level.

The carcass percentage (%), or the ratio of dressed weight to live weight of chickens, ranged from 65% to 68% in the current study, and analysis of variance showed that there was not significant difference among the treatment groups whether in terms of BPF preparation, frequency, or both. The results on relative organ weights for the edible organs (liver, spleen, gizzard and heart) also revealed non-significant

differences among treatments and frequency. These results concur with published researches where carcass traits were mostly not affected by supplementation (Nicolas, 2017).

Conclusion

Based on the results of the experiment, the production performance, specifically body weight, average daily gain, and feed conversion ratio, revealed highly significant differences among different treatments and frequencies. Among treatments, butterfly pea flower–fermented juice (10%) in drinking water produced the best results, followed by butterfly pea flower–decoction. Between the frequencies, it was everyday supplementation that had the better obtained performance values.

No significant differences were observed among treatments and frequencies on dressed weight, carcass percentage, and relative organ weights for the edible organs such as liver, spleen, gizzard, and heart.

Recommendations

For improved broiler performance, butterfly pea flower (fermented plant juice) 10% in drinking water may be administered every day to broiler chickens starting day 8 of age. Further studies on the butterfly pea flower varieties in the province of Bulacan and in the country may be studied as supplement in feed and drinking water of broilers and other farm animals, to ascertain their beneficial effects on production performance, as affected by different environmental conditions, management practices, or physiological mechanisms.

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