

## Caponisation in *Pati* ducks (*Anas platyrhynchos domesticus*)

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The study was carried out to explore the suitable caponisation age and its effect on growth performance and carcass quality of *Pati* ducks. A total of 24 male *Pati* ducks were used in four equal groups. The birds of group B, C and D were caponised at 8, 10 and 12 weeks of age, respectively, while group A was kept as intact. Ducks of all groups were raised until 24 weeks of age. The caponisation times (minute) recorded were  $31.50 \pm 0.96$ ,  $35.00 \pm 0.77$  and  $34.83 \pm 1.44$ , respectively, in groups B, C, and D. There was no mortality observed in any group during the entire period of study. The physiological and biochemical parameters following caponisation revealed non-significant and significant variation within physiological limit, respectively. Carcass characteristics of the capon bird attribute was better compared to intact bird. It was revealed that the most suitable age for caponisation of *Pati* ducks was 12 weeks with better carcass qualities. The surgical caponisation was found to have little or no effect on the physiological parameters at different time intervals in all groups. **Keywords:** Caponisation, Carcass characteristics, *Pati* duck, Physiological and biochemical parameters

Caponisation is a boon for rural farmers to raise the body weight of the male birds as well as to improve the meat quality and profit margin. The World Organisation for Animal Health (OIE) standard for surgical caponising states that it can only be carried out by veterinarians or other qualified individuals working under a veterinarian's supervision and that it must be done with the correct techniques to control pain and infection. According to 20<sup>th</sup> Livestock Census, Govt. of India (2019), ducks constitute about 3.8% (32.5 million) of the total poultry (851.8 million) population in India. With 12 million ducks, the Assam has the second-highest duck population in India. The *Pati* duck (*Anas platyrhynchos domesticus*) is the most reared indigenous non-descript duck breed under backyard systems in the state of Assam (Islam *et al.*, 2002; Deka *et al.*, 2015). The mean adult body weights of male and female *Pati* ducks were reported as 1.040 kg and 0.990 kg, respectively (Phookan *et al.*, 2018). The available literature on the effect of the caponisation on growth parameters and carcass characteristics in *Pati* duck is lacking. The current study was carried out to evaluate the effects of caponisation in *Pati* duck on its growth and carcass characteristics as well as to explore the suitable age for caponisation.

### Materials and Methods

The study was conducted on 24 male *Pati* ducks, which were randomly divided into four groups comprising of 6 birds each. In group A, the birds were kept as intact (uncastrated), while caponisation was carried out in the birds of group B, C and D at 8 weeks, 10 weeks and 12 weeks of age, respectively. Feed was withdrawn for 12 hr before the surgical caponisation, however water was provided uninterruptedly. The birds were spread out to their full length, the wings and legs secured, so that the last intercostal region was made visible to remove feathers from the area under routine aseptic procedure. The local analgesia was achieved by infiltration of 2 % lignocaine HCl along the line of incision (Akter *et al.*, 1996; Calik *et al.*, 2020).

The middle finger of the left hand was placed over the hip region, and the skin was pulled forward towards the head. The skin was held in a forward position, the last intercostal space was felt with the index finger, and an incision was made with a BP blade. By blunt dissection, the sartorius muscle was separated and pushed caudally from the oblique abdominal muscles, and curved haemostatic forceps was inserted between the external and internal oblique muscles. The peritoneal cavity was penetrated by incising the transverses abdominus and peritoneum with Metzenbaum scissors. The ribs were held apart by a spreader, and the upper testicle was located first, corresponding to which, on the opposite side, lay the lower testicle. Skin hook surgical retractor was used to tease the testicle away from the tough mesorchium and hold the testicle with the Babcock forceps. After giving the Babcock forceps a few twists and traction, the organs were carefully removed. Both testicles of all the ducks were removed through a single incision. The lower testicle was removed first, so that even if there was slight bleeding the upper testicle could be removed without much difficulty. The incisions were left unstitched, and stretched skin was released to slide over the incisions made at the muscle layers.

The parameters such as the duration of surgery (caponisation time in minutes) was recorded from the physical restraining of the birds to the removal of both testicles (Songsee *et al.*, 2020). The bird mortality

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during pre- and post-surgical period was recorded. The physiological parameters *viz.*, cloacal temperature (°F), heart rate (beats/min), respiratory rate (breaths/min) and biochemical parameters (total protein, glucose, cholesterol and triglycerides) were recorded on 0, 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> day following caponisation. The body weights of the birds were taken on arrival, before surgical caponisation and then every fortnight until the age of 24 weeks.

Carcass characteristics of slaughtered birds such as dressing percentages, organoleptic evaluation (subjective and objective) were carried out as per the standard methods. The statistical analysis of the data was carried out by one-way ANOVA or two-way ANOVA followed by pair wise multiple comparisons using pairwise t-test with Bonferroni correction. All the analysis was carried out in statistical software R (version 4.1.0) (R core team) (Logan, 2010).

**Results and Discussion**

The mean±SE values of caponisation time (minutes) were recorded as 31.50±0.96, 35.00±0.77, and 34.83±1.44 in group B, C, and D, respectively. The caponisation time did not vary significantly among the groups. The mean caponisation time for birds in all the groups was more than 30 min, which was much more than the time reportedly taken by Friedlander *et al.* (1986), Rikimaru *et al.* (2011), and Songsee *et al.* (2020) in chickens. This could be due to the variation in the condition, and species and anatomical differences in locating reproductive organs.

During the entire period of the study, no mortality was observed in any group. Similar observation was made by Lei *et al.* (2022) in gander capons and intact. In contrast, several authors have reported mortality of varying degrees in caponised and intact birds (Friedlander *et al.*, 1986; Burke and Edwards, 1994; Lin

**Table 1:** Mean±SE of various physiological and biochemical parameters in different groups at different time intervals in *Pati* duck.

Parameter	Groups	Days				
		0	2	4	6	8
Heart Rate X	A	190.17±1.35	191.00±3.01	188.83±2.70	187.83±1.64	189.00±0.93
	B	189.83±2.41	191.33±0.99	188.67±1.96	188.70±1.40	188.83±2.37
	C	188.17±3.32	189.67±1.38	187.33±2.60	189.67±1.72	189.00±0.86
	D	189.33±1.58	188.33±1.89	189.33±1.67	190.67±0.67	190.00±1.71
Respiratory Rate (breaths/min)	A	28.83±0.60	29.33±0.67	29.33±0.71	29.50±0.76	29.17±0.60
	B	29.33±0.71	28.67±0.67	29.83±0.87	29.83±0.65	30.50±0.96
	C	30.83±1.08	30.33±0.88	31.00±1.13	28.00±0.51	29.50±0.71
	D	28.50±0.99	29.50±0.76	29.17±0.70	30.33±0.84	29.17±0.95
Cloacal Temperature (°F)	A	107.07±0.07	107.31±0.10	107.23±0.16	107.08±0.12	107.28±0.07
	B	107.20±0.07	107.13±0.21	107.1±0.12	107.07±0.10	107.18±0.07
	C	107.38±0.13	107.15±0.10	107.05±0.18	107.02±0.06	107.08±0.09
	D	107.17±0.05	107.13±0.08	107.27±0.15	107.13±0.15	107.17±0.08
Serum Cholesterol (mg/dL)	A	192.05±0.48 <sup>A</sup> <sub>a</sub>	192.42±0.49 <sup>AB</sup> <sub>a</sub>	193.06±0.46 <sup>AB</sup> <sub>a</sub>	193.61±0.48 <sup>BC</sup> <sub>a</sub>	194.20±0.42 <sup>C</sup> <sub>a</sub>
	B	192.09±0.55 <sup>A</sup> <sub>a</sub>	192.44±0.51 <sup>AB</sup> <sub>a</sub>	193.31±0.39 <sup>BC</sup> <sub>a</sub>	194.03±0.32 <sup>CD</sup> <sub>a</sub>	194.63±0.27 <sup>D</sup> <sub>a</sub>
	C	195.08±0.18 <sup>A</sup> <sub>b</sub>	195.55±0.24 <sup>AB</sup> <sub>b</sub>	195.94±0.24 <sup>ABC</sup> <sub>b</sub>	196.32±0.27 <sup>BC</sup> <sub>b</sub>	196.79±0.28 <sup>C</sup> <sub>b</sub>
	D	197.19±0.15 <sup>A</sup> <sub>c</sub>	197.74±0.16 <sup>AB</sup> <sub>c</sub>	198.29±0.13 <sup>ABC</sup> <sub>c</sub>	198.71±0.15 <sup>BC</sup> <sub>c</sub>	199.15±0.19 <sup>C</sup> <sub>c</sub>
Serum Glucose (mg/dL)	A	70.95±0.40 <sup>A</sup> <sub>a</sub>	71.52±0.28 <sup>AB</sup> <sub>a</sub>	71.99±0.30 <sup>BC</sup> <sub>a</sub>	72.28±0.29 <sup>BC</sup> <sub>a</sub>	72.64±0.49 <sup>C</sup> <sub>a</sub>
	B	71.22±0.35 <sup>A</sup> <sub>a</sub>	71.67±0.25 <sup>AB</sup> <sub>a</sub>	72.13±0.24 <sup>BC</sup> <sub>a</sub>	72.49±0.23 <sup>BC</sup> <sub>a</sub>	73.01±0.31 <sup>C</sup> <sub>a</sub>
	C	73.58±0.25 <sup>A</sup> <sub>b</sub>	74.15±0.24 <sup>AB</sup> <sub>b</sub>	74.93±0.24 <sup>BC</sup> <sub>b</sub>	75.37±0.27 <sup>C</sup> <sub>b</sub>	75.63±0.31 <sup>C</sup> <sub>b</sub>
	D	76.01±0.23 <sup>A</sup> <sub>c</sub>	76.17±0.26 <sup>AB</sup> <sub>c</sub>	76.66±0.23 <sup>ABC</sup> <sub>c</sub>	77.06±0.22 <sup>BC</sup> <sub>c</sub>	77.39±0.23 <sup>C</sup> <sub>c</sub>
Serum Total Protein (g/dL)	A	2.87±0.12 <sup>A</sup> <sub>a</sub>	2.97±0.13 <sup>AB</sup> <sub>a</sub>	3.09±0.11 <sup>AB</sup> <sub>a</sub>	3.19±0.11 <sup>AB</sup> <sub>a</sub>	3.26±0.10 <sup>B</sup> <sub>a</sub>
	B	3.03±0.13 <sup>A</sup> <sub>a</sub>	3.12±0.13 <sup>AB</sup> <sub>a</sub>	3.22±0.12 <sup>ABC</sup> <sub>a</sub>	3.36±0.10 <sup>BC</sup> <sub>a</sub>	3.47±0.10 <sup>C</sup> <sub>a</sub>
	C	3.51±0.07 <sup>A</sup> <sub>b</sub>	3.59±0.07 <sup>A</sup> <sub>b</sub>	3.63±0.08 <sup>A</sup> <sub>b</sub>	3.74±0.10 <sup>A</sup> <sub>b</sub>	3.82±0.09 <sup>A</sup> <sub>b</sub>
	D	3.63±0.10 <sup>A</sup> <sub>b</sub>	3.72±0.10 <sup>AB</sup> <sub>b</sub>	3.85±0.07 <sup>AB</sup> <sub>b</sub>	3.95±0.09 <sup>B</sup> <sub>b</sub>	4.01±0.07 <sup>B</sup> <sub>b</sub>
Serum Triglyceride (mg/dL)	A	191.48±0.48 <sup>A</sup> <sub>a</sub>	192.65±0.46 <sup>B</sup> <sub>a</sub>	194.36±0.37 <sup>C</sup> <sub>a</sub>	195.46±0.31 <sup>C</sup> <sub>a</sub>	196.68±0.24 <sup>D</sup> <sub>a</sub>
	B	191.37±0.31 <sup>A</sup> <sub>a</sub>	192.64±0.31 <sup>B</sup> <sub>a</sub>	194.69±0.23 <sup>C</sup> <sub>a</sub>	195.90±0.31 <sup>D</sup> <sub>a</sub>	196.99±0.26 <sup>D</sup> <sub>a</sub>
	C	202.65±0.32 <sup>A</sup> <sub>b</sub>	204.04±0.37 <sup>B</sup> <sub>b</sub>	205.98±0.29 <sup>C</sup> <sub>b</sub>	207.40±0.25 <sup>D</sup> <sub>b</sub>	208.72±0.25 <sup>E</sup> <sub>b</sub>
	D	214.85±0.23 <sup>A</sup> <sub>c</sub>	216.15±0.41 <sup>B</sup> <sub>c</sub>	218.43±0.35 <sup>C</sup> <sub>c</sub>	219.94±0.43 <sup>D</sup> <sub>c</sub>	221.79±0.51 <sup>E</sup> <sub>c</sub>

Means with different superscripts (capital letter) in a row differ significantly (P<0.01) Means with different subscripts (small letter) in a column differ significantly (P<0.01)

and Hsu, 2002; Tor *et al.*, 2002; Severin *et al.*, 2006; Severin *et al.*, 2007; Miguel *et al.*, 2008; Symeon *et al.*, 2010; Rikimaru *et al.*, 2011; Franco *et al.*, 2016; Songsee *et al.*, 2020; Aikpitanyi *et al.*, 2020 and Hossen *et al.*, 2021). The probable reason for no mortality in the present study could be due to the umpteen care taken during intra-caponisation and pre-caponisation, the rearing of ducks, and the desi duck's natural surviving skills.

The mean±SE values of physiological parameters *viz.*, heart rate, respiratory rate and cloacal temperature of the birds in the different groups did not vary significantly ( $P>0.05$ ). There was no significant difference among the various days as well in different groups (Table 1). These findings were in accordance with the observations of Butler and Woakes (1979), Abbasi *et al.* (2014), Mutibvu *et al.* (2017) and Krunt *et al.* (2022). However, Marais *et al.* (2011) and Krunt *et al.* (2022) observed cloacal temperature of 40.8° C to 41.1° C in Pekin ducks and 40.3° C in male ducks, respectively under similar stress condition. Non-significant variations in physiological parameters in this study might indicate that the ducks had coped with the stress caused by the surgical procedure.

The mean values of different biochemical parameters *viz.*, serum cholesterol, serum glucose, serum total protein and serum triglyceride varied significantly among the groups and days of observation; however, the values were within the physiological range. The mean values of biochemical parameters elevated non-significantly with increase in age in all groups. Similar observations were made by Sinha *et al.* (2017) in *Pati* ducks, Lei *et al.* (2022) in ganders and Lei *et al.* (2022) in pheasants. The mean cholesterol values were non significantly higher in caponised ducks (group B) than in intact ducks (group A), as also reported by Akter *et al.* (1996) in ISA brown birds, Rahman *et al.* (2004) in Nara cockerels, Severin *et al.* (2006) in pheasants, Shao *et al.* (2009) in Tibetan chickens, and Lei *et al.* (2022) in ganders. The mean glucose values were also non-significantly higher in caponised ducks (group B) than in intact ducks (group A). Similar findings were reported by Severin *et al.* (2006) in pheasants, Shao *et al.* (2009) in Tibetan chickens, and Lei *et al.* (2022) in ganders. The differences in the mean values observed in the study during pre- and post-caponisation days between and within the groups were due to the different caponisation ages. The non-significant variation in glucose values between groups A and B on pre-caponisation and post-caponisation days suggests that caponisation does not accelerate fat deposition by raising glucose concentration (Shao *et al.*, 2009). The mean total protein values were also non-significantly higher in caponised ducks of group B than in intact ducks (group A), similar finding was also reported by Severin *et al.* (2006) in pheasants. The differences in the mean values of total protein observed during pre-

caponisation and post-caponisation days between and within the groups might be attributed to the different caponisation ages. The non-significant variation in total protein values between groups A and B indicate that caponisation did not have a significant effect on the total protein concentration. In the study, mean values increased with age, as also reported by Sinha *et al.* (2017). Similar increase in triglyceride levels was also reported by Lei *et al.* (2022) in pheasants. However, Severin *et al.* (2006) observed non significantly lower triglyceride levels in the pheasant capon than the pheasant. The differences in the mean values observed in the study during pre-caponisation and post-caponisation days between and within the groups were probably due to the different caponisation ages. The slightly higher serum triglyceride concentration might be due to the lower serum testosterone levels caused by caponisation depressing lipase and enzymes related to fat metabolism, thereby increasing the triacylglycerol levels in the serum (Lei *et al.*, 2022).

**Table 2:** Mean±SE of body weight (kg) in different groups at different age (weeks).

Age (weeks)	Groups			
	A	B	C	D
6	0.55±0.03 <sup>A</sup>	0.54±0.01 <sup>A</sup>	0.59±0.01 <sup>A</sup>	0.53±0.02 <sup>A</sup>
8	0.68±0.03 <sup>B</sup>	0.65±0.03 <sup>B</sup>	0.69±0.02 <sup>B</sup>	0.67±0.01 <sup>B</sup>
10	0.82±0.03 <sup>C</sup>	0.74±0.02 <sup>B</sup>	0.82±0.02 <sup>C</sup>	0.8±0.02 <sup>C</sup>
12	1.01±0.05 <sup>D</sup>	0.91±0.03 <sup>C</sup>	0.86±0.02 <sup>C</sup>	0.97±0.03 <sup>D</sup>
14	1.17±0.05 <sup>E</sup>	1.12±0.04 <sup>D</sup>	1.04±0.04 <sup>D</sup>	1.01±0.03 <sup>D</sup>
16	1.22±0.03 <sup>F</sup>	1.28±0.03 <sup>E</sup>	1.21±0.03 <sup>E</sup>	1.19±0.03 <sup>E</sup>
18	1.36±0.02 <sup>G</sup>	1.41±0.04 <sup>F</sup>	1.38±0.03 <sup>F</sup>	1.4±0.01 <sup>F</sup>
20	1.44±0.04 <sup>H</sup>	1.55±0.04 <sup>G</sup>	1.50±0.04 <sup>G</sup>	1.51±0.03 <sup>G</sup>
22	1.51±0.03 <sup>I</sup>	1.64±0.02 <sup>H</sup>	1.65±0.02 <sup>H</sup>	1.67±0.01 <sup>H</sup>
24	1.52±0.04 <sup>I</sup>	1.67±0.03 <sup>H</sup>	1.66±0.02 <sup>H</sup>	1.71±0.01 <sup>H</sup>

Means with different superscripts within a column differ significantly ( $P < 0.01$ ).

The mean±SE values of body weight (kg) of the ducks in different treatment groups and control differed significantly ( $P=3.3E-147$ ) among the various ages (week) within group (6<sup>th</sup>, 8<sup>th</sup>, 10<sup>th</sup>, 12<sup>th</sup>, 14<sup>th</sup>, 16<sup>th</sup>, 18<sup>th</sup>, 20<sup>th</sup>, 22<sup>nd</sup>, and 24<sup>th</sup>) and differed not significantly ( $P=0.24$ ) between groups (Table 2). The mean values of body weight at 24 weeks were non-significantly higher in birds of group B, C and D than in group A. The highest body weight was recorded in birds of group D at the end of the study. Similar findings were also reported by Rikimaru *et al.* (2011) in meat-type chickens and Muszynski *et al.* (2017) in Polbar chicken capons. However, Rahman *et al.* (2004) in Nara chicken, Duran (2004) in Extremena Azul chicken, Chen *et al.* (2005) in Taiwan country chicken, Severin *et al.* (2007) in pheasants, Mahmud *et al.* (2014) in cockerel chickens, Calik *et al.* (2015) in Green Leg Partridge cockerels, Aikpitanyi *et al.* (2020) in ISA Brown

Cockerels, Calik *et al.* (2020) in crossbreed chicken, Hossen *et al.* (2021) in Sonali Cockerels, and Lei *et al.* (2022) in geese found significantly higher body weights in capons than in intact birds. This might be due to the length of post-surgical rearing of the birds. In the present study, the findings were recorded till 24 weeks of age, and capons showed a non-significant difference with the intact ducks. Significantly less body weight gain two weeks after caponisation was observed in all the ducks (Welter, 1976; Lin and Hsu, 2002; Duron, 2004; Muszynski *et al.*, 2017). The significantly lower body weight gain might be the result of pre-caponisation fast and surgical procedure causing psychological and physiological stress on the birds.

The mean values for the attributes flavour, texture, juiciness, and overall acceptability in the present study were significantly higher in group D than in groups A, B and C. The mean values for lightness ( $L^*$ ) were significantly higher in capons than in intact birds, and the variations in mean values for yellowness ( $b^*$ ) and redness ( $a^*$ ) did not show any significant difference among the groups. The mean values of shear force of meat in intact birds were found to be higher than in capons. The variations in mean values of chewiness were found to be significantly higher in intact than in capons. Other parameters like springiness and cohesiveness did not differ significantly among the groups. These findings were in accordance with observation of Rikimaru *et al.* (2009) in intact Hina-Jidori cockerels, Sirri *et al.* (2009) in crossbred cockerels, Symeon *et al.* (2010) in medium-growth broilers, Calik (2014) in roosters, Calik *et al.* (2015) in Greenleg Partridge cockerels, Franco *et al.* (2016) in Sasso and Mos cockerels, and Quaresma *et al.* (2017) in roosters.

From the results of this study, it was concluded that the most suitable age for the caponisation of Pati duck was 12 weeks with better carcass characteristics.

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