RESULTS

4.0 RESULTS

The results of the present investigation on the efficacy of plant wastes (vegetable and fruit wastes), animal wastes (broiler and fish wastes), probiotics, medicinal herbs and veterinary growth promoters on growth, nutritional indices and feed utilization efficiencies of Indian major carp, *Catla catla* are presented below.

4.1 PHASE-1

PLANT AND ANIMAL WASTES SUPPLEMENTATION

4.1.1 Nutritional assessment

Proximate composition such as protein, carbohydrate and fat contents in the control, plant and animal wastes supplemented feeds were estimated and are presented in Table 1.

Plant and animal wastes incorporation improved the nutritive value of experimental feeds than the control feed. Among the twelve different feeds prepared for the present experiment, the maximum protein and carbohydrate contents (37.91 and 13.51%) were estimated in T_{12} feed, prepared from 30 % fish wastes and 70% rice bran and groundnut oil cake. Feed (T_9) prepared from 30% broiler wastes and 70% rice bran and groundnut oil cake showed highest fat content (15.32%). The minimum protein, carbohydrate and fat contents were noticed in the control feed prepared from rice bran and groundnut oil cake in 1:1 ratio and the contents analysed were 34.12, 12.81 and 14.01% respectively.

Fish wastes incorporated feed (T_{12}) showed highest protein, carbohydrate and fat contents, followed by broiler, fruit and vegetable wastes included feeds. The difference in protein, carbohydrate and fat contents recored in twelve different feeds were found to be statistically significant ($P<0.05$) when compared to control.

4.1.2 Growth parameters

Growth parameters such as weight gain, length gain and specific growth rate (weight and length) in *C.catla* grown in the control and twelve different treatments were studied during 15, 30, 45 and 60 days of the feeding experiment and are presented in Tables 2 to 5.

Weight gain

Weight gain of *C.catla* fed with control and various experimental diets during different days of the experiment is shown in Table 2. Plant and animal wastes supplementation improved weight gain in all the experimental fishes than the control. However, of all the treatments and control, during 15, 30, 45 and 60 days of the experiment the maximum weight gain (31.23, 58.81, 82.22 and 104.21% respectively) was recorded in T_{12} fishes fed with supplemented diet containing 30% fish wastes. The minimum weight gain (11.33, 21.83, 34.14 and 40.02%) was noticed during 15, 30, 45 and 60 days of the experiment in the control fishes. Fishes exposed to different experimental diets vary significantly ($P<0.05$) in their weight gain.

Length gain

Length gain of *C.catla* during different days of the experiment in relation to the various diets prepared for the present study is presented in Table 3. All the experimental diets prepared from vegetable, fruit, broiler and fish wastes improved the length gain in *C.catla* than the control feed. Among the twelve different treatments and control, length gain during 15, 30, 45 and 60 days of the experiment was highest (19.15, 46.81, 85.11 and 119.15%) in *C.catla* grown in T_{12} feed, whereas lowest length gain (8.92, 13.41, 17.08 and 25.19%) was obtained in control feed fed fishes. *C.catla* grown in the twelve different treatments showed statistically significant ($P<0.05$) length gain than the control fishes.

Specific growth rate

Specific growth rate (weight and length) of fishes fed with control and different experimental diets are shown in Tables 4 and 5. During 15, 30, 45 and 60 days of the experiment highest specific growth rate (weight) (0.96, 1.42, 1.66 and 1.84%) was recorded in fishes fed with T_{12} feed and lowest (0.23, 0.70, 1.03 and 1.14%) was obtained in the control fishes. Similarly, T_{12} fishes exhibited highest specific growth rate (length) (0.81, 1.46, 1.89 and 2.13%) and fishes grown in the control feed showed lowest values of 0.26, 0.55, 0.73 and 1.01% during 15, 30, 45 and 60 days of the experiment. *C.catla* fed with plant and animal wastes incorporated diets differs significantly ($P<0.05$) in their specific growth rate values.

4.1.3 Biochemical composition

Biochemical composition such as water content, protein, carbohydrate, fat, ash and calorific content in the muscle tissues of *C.catla* in the control and twelve different treatments were estimated before and the after the experimental period and are presented in Figures 1 to 6.

Before exposure to the different experimental feeds protein, carbohydrate and fat contents in the muscle tissues of *C.catla* were estimated to be 17.12, 4.21 and 2.31%. After 60 days of the feeding experiment all the experimental fishes showed highest protein, carbohydrate and fat content values. However, the maximum protein (19.66%), carbohydrate (6.02%) and fat contents (3.41%) were obtained in T_{12} fishes and the minimum values of 18.08, 4.57 and 2.58% were recoreded in the control fishes.

Calorific content estimated in the experimental fshes before starting the experiment was 135.88 Kcal/gm. Plant and animal supplementation improved the calorific content in all the experimental fishes (T_1 -T_{12}) and highest value (168.04 Kcal/gm) was noticed in T_{12} fishes. Fishes grown in the control feed exhibited lowest calorific content (145.27 Kcal/gm) than the other treatments.

Water and ash contents recorded in the fishes at the beginning of the experiment were 72.36 and 1.87%. After the experimental period of 60 days, water and ash contents were maximum (79.27 and 3.22%) in T_{12} fishes and minimum values of 73.29 and 2.30% were noiticed in the control fishes.

Muscle proximate composition of the experimental fishes was increased after 60 days feeding of plant and animal wastes supplemented diets. All these biochemical parameters when analysed statistically the results were found to be significant at $P< 0.05$.

4.1.4 Feed utilization efficiencies

Feed utilization efficiencies such as feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV) and feed efficiency (FE) of *C.catla* fingerlings were analysed after 60 days of the experimental period and are summarized in Table 6.

Feed conversion ratio

Feed conversion ratio showed significant variation ranged between 1.53 to 2.53% in control and twelve different treatments. Among the different treatments, maximum feed conversion ratio (2.53%) was obtained in fishes fed with control feed and minimum (1.53%) was recorded in fishes fed with T_{12} feed. The difference in feed conversion ratio found among fishes of different treatments was found to be statistically significant ($P<0.05$).

Protein efficiency ratio

Protein efficiency ratio of the control and experimental fishes after 60 days of the experimental period was varied from 1.69 to 2.88%. The highest protein efficiency ratio of 2.88% was obtained in *C.catla* grown in T_{12} diet, whereas lowest protein efficiency ratio (1.69%) was recorded in control feed fed fishes.

Fishes exposed to plant and animal wastes supplemented feeds exhibited significant ($P<0.05$) protein efficiency ratio than the control fishes.

Protein productive value

Among the twelve different treatments and control, protein productive values were varied and ranged from 3.04 to 7.04%. After the experimental period of 60 days, *C.catla* fed with T_{12} feed showed maximum (7.04%) protein productive value, whereas the minimum value of 3.04% was noticed in control fishes. Fishes fed with different experimental diets differs significantly ($P<0.05$) in their protein productive values.

Feed efficiency

After 60 days of the experimental period, feed efficiency values recorded in *C.catla* were ranged from 25.01 to 65.13%. Among the different treatments, fishes fed with 30% fish wastes supplemented diet showed maximum feed efficiency (65.13%) and minimum (25.01%) was observed in control feed fed fishes. The difference in feed efficiency values found among fishes of different treatments was found to be statistically significant ($P<0.05$).

TABLE - 1

Protein, carbohydrate and fat contents (%) in the control, plant and animal wastes supplemented feeds.

Feed	Treatments	Concentrations (%)	Protein	Carbohydrate	Fat
Control	C	---	34.12	12.81	14.01
Vegetable wastes	T_1	10	35.25	13.01	14.36
	T_2	20	35.54	13.25	14.49
	T_3	30	35.73	13.25	14.51
Fruit wastes	T_4	10	35.53	13.09	14.51
	T_5	20	35.66	13.28	14.55
	T_6	30	35.93	13.37	14.58
Broiler wastes	T_7	10	36.61	13.26	14.83
	T_8	20	36.83	13.40	15.12
	T_9	30	36.96	13.47	15.32
Fish wastes	T_{10}	10	36.63	13.36	14.63
	T_{11}	20	37.52	13.48	14.91
	T_{12}	30	37.91	13.51	15.01
SED			0.0135	0.0049	0.0055
CD (0.05)			0.0273	0.0100	0.0111

Values are the mean of three replicates

TABLE - 2

Weight gain (%) in *Catla catla* during different days of the experiment in the control, plant and animal wastes supplemented feeds.

Feed	Treatments	Concentrations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	11.33	21.83	34.14	40.02
Vegetable wastes	T_1	10	16.31	31.29	54.29	65.51
	T_2	20	19.43	37.65	60.24	75.15
	T_3	30	21.75	40.13	63.11	78.14
Fruit wastes	T_4	10	18.11	33.26	56.11	69.28
	T_5	20	22.13	43.16	68.86	81.08
	T_6	30	24.01	45.36	71.26	84.79
Broiler wastes	T_7	10	20.25	47.22	60.41	78.86
	T_8	20	26.16	49.24	75.18	96.41
	T_9	30	28.32	51.80	78.03	98.27
Fish wastes	T_{10}	10	21.28	49.82	68.36	82.15
	T_{11}	20	29.93	55.31	79.20	98.38
	T_{12}	30	31.23	58.81	82.22	104.21
SED			0.0080	0.0152	0.0234	0.0292
CD (0.05)			0.0161	0.0307	0.0473	0.0591

Values are the mean of three replicates

TABLE - 3

Length gain (%) in *Catla catla* during different days of the experiment in the control, plant and animal wastes supplemented feeds.

Feed	Treatments	Concentrations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	8.92	13.41	17.08	25.19
Vegetable wastes	T_1	10	10.73	21.07	32.86	41.33
	T_2	20	12.07	29.04	63.95	90.09
	T_3	30	12.77	30.45	65.86	91.49
Fruit wastes	T_4	10	12.13	22.12	35.11	44.16
	T_5	20	14.13	37.51	73.30	98.75
	T_6	30	14.89	38.30	74.47	100.00
Broiler wastes	T_7	10	13.28	26.82	38.88	51.43
	T_8	20	16.78	41.88	79.33	106.65
	T_9	30	17.39	43.48	80.44	108.70
Fish wastes	T_{10}	10	15.12	29.15	66.31	93.19
	T_{11}	20	18.33	45.14	84.76	117.89
	T_{12}	30	19.15	46.81	85.11	119.15
SED			0.0050	0.0117	0.0221	0.0301
CD (0.05)			0.0101	0.0236	0.0448	0.0610

Values are the mean of three replicates

TABLE - 4

Specific growth rate in percentage (weight) in *Catla catla* during different days of the experiment in the control, plant and animal wastes supplemented feeds.

Feed	Treat ments	Concen trations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.23	0.70	1.03	1.14
Vegetable wastes	T_1	10	0.49	0.97	1.36	1.50
	T_2	20	0.62	1.10	1.44	1.60
	T_3	30	0.70	1.15	1.47	1.63
Fruit wastes	T_4	10	0.57	1.01	1.39	1.54
	T_5	20	0.71	1.20	1.54	1.65
	T_6	30	0.77	1.23	1.56	1.69
Broiler wastes	T_7	10	0.65	1.20	1.44	1.63
	T_8	20	0.84	1.29	1.60	1.78
	T_9	30	0.89	1.33	1.63	1.79
Fish wastes	T_{10}	10	0.69	1.30	1.53	1.66
	T_{11}	20	0.93	1.38	1.64	1.80
	T_{12}	30	0.96	1.42	1.66	1.84
SED			0.0002	0.0004	0.0005	0.0008
CD (0.05)			0.0005	0.0008	0.0011	0.0016

Values are the mean of three replicates

TABLE - 5

Specific growth rate in percentage (length) in *Catla catla* during different days of the experiment in the control, plant and animal wastes supplemented feeds.

Feed	Treat ments	Concen trations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.26	0.55	0.73	1.01
Vegetable wastes	T_1	10	0.39	0.88	1.20	1.37
	T_2	20	0.47	1.11	1.68	1.93
	T_3	30	0.52	1.14	1.71	1.94
Fruit wastes	T_4	10	0.48	0.92	1.25	1.42
	T_5	20	0.59	1.30	1.78	2.00
	T_6	30	0.63	1.31	1.79	2.01
Broiler wastes	T_7	10	0.55	1.05	1.32	1.53
	T_8	20	0.72	1.38	1.81	2.05
	T_9	30	0.74	1.40	1.84	2.07
Fish wastes	T_{10}	10	0.64	1.11	1.72	1.95
	T_{11}	20	0.78	1.43	1.85	2.13
	T_{12}	30	0.81	1.46	1.89	2.13
SED			0.0002	0.0004	0.0006	0.0007
CD (0.05)			0.0004	0.0008	0.0012	0.0013

Values are the mean of three replicates

TABLE - 6

Feed utilization efficiencies (%) of *Catla catla* in the control, plant and animal wastes supplemented feeds.

Feed	Treatments	Concentrations (%)	FCR	PER	PPV	FE
Control	C	---	2.53	1.69	3.04	25.01
Vegetable wastes	T_1	10	2.11	2.02	3.85	40.94
	T_2	20	1.69	2.08	4.65	46.97
	T_3	30	1.64	2.32	5.83	48.84
Fruit wastes	T_4	10	1.98	2.22	3.91	43.30
	T_5	20	1.62	2.28	4.92	50.68
	T_6	30	1.61	2.44	6.07	53.00
Broiler wastes	T_7	10	1.83	2.34	4.49	49.29
	T_8	20	1.60	2.61	5.19	60.26
	T_9	30	1.54	2.72	6.40	61.49
Fish wastes	T_{10}	10	1.83	2.35	4.78	51.34
	T_{11}	20	1.57	2.62	5.51	61.42
	T_{12}	30	1.53	2.88	7.04	65.13
SED			0.0007	0.0019	0.0008	0.0182
CD (0.05)			0.0014	0.0039	0.0017	0.0369

Values are the mean of three replicates

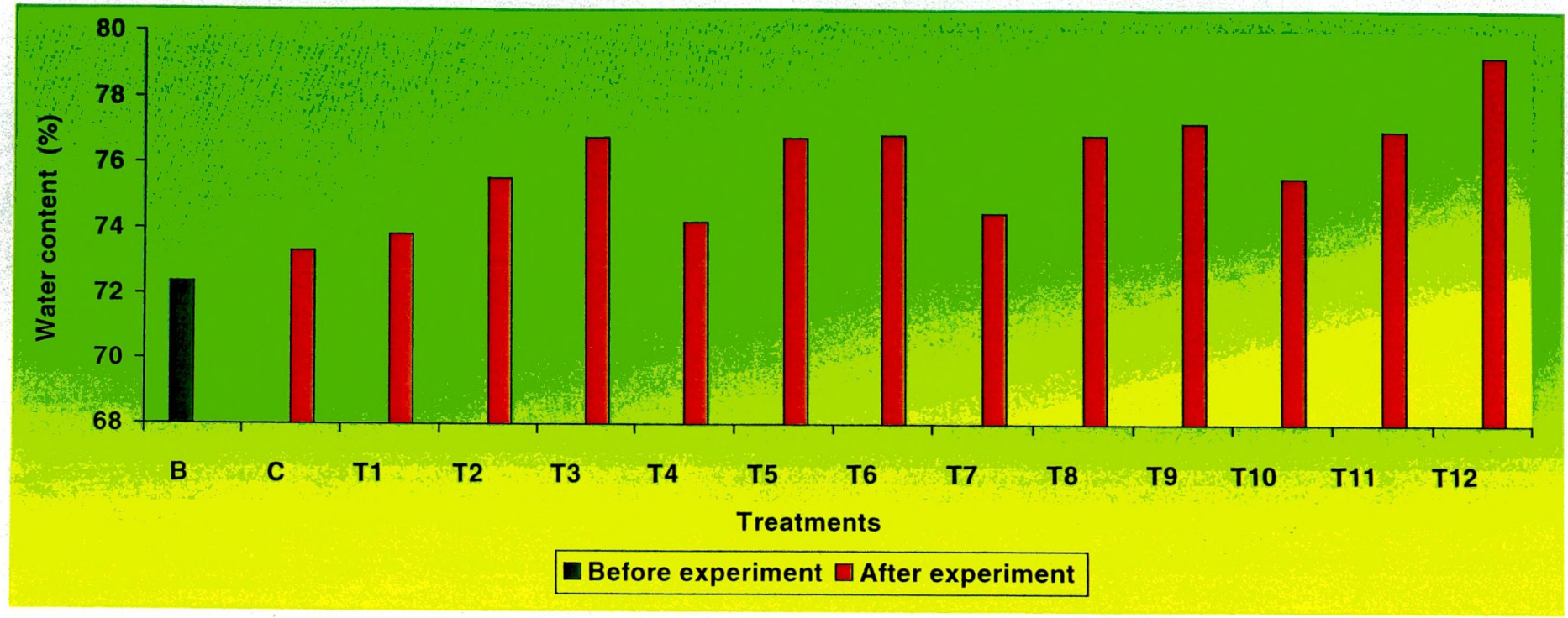

Figure - 1

Water content (%) in the muscle tissues of *Catla catla* in the control, plant and animal wastes supplemented feeds before and after experiment.

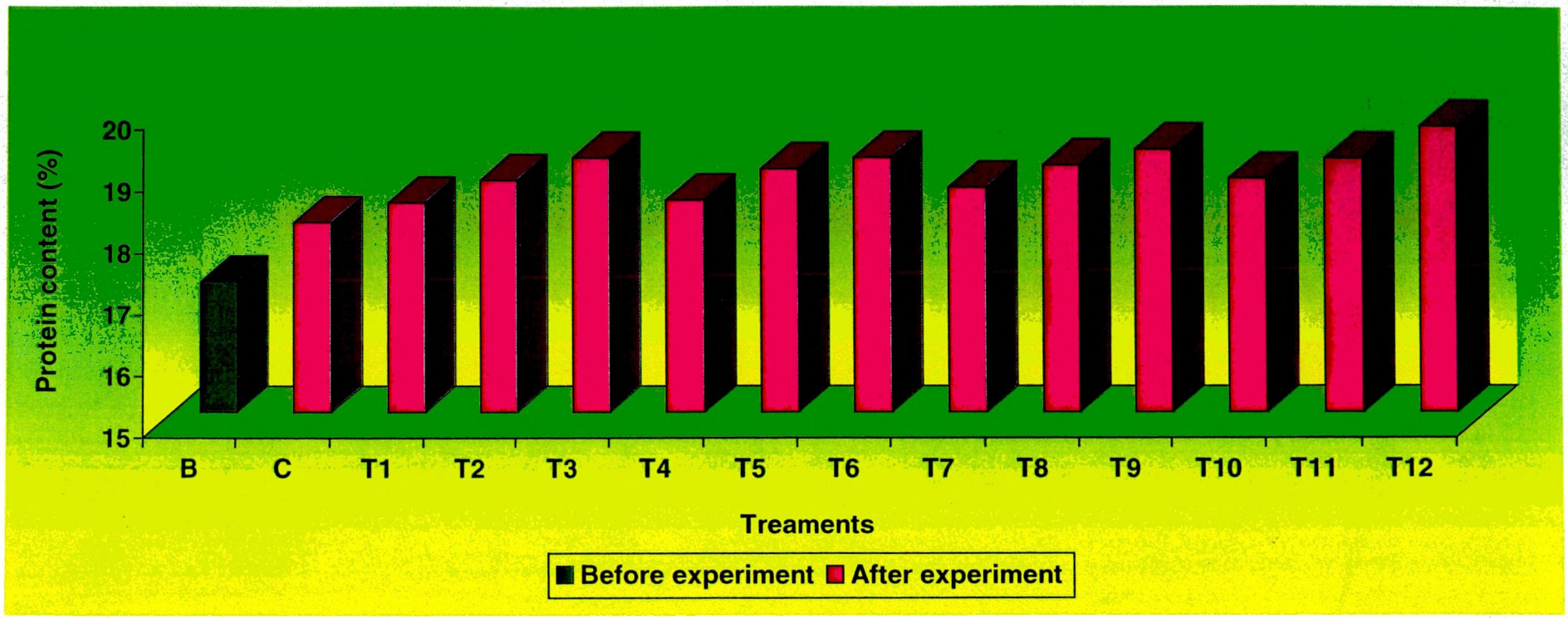

Figure - 2

Protein content (%) in the muscle tissues of *Catla catla* in the control, plant and animal wastes supplemented feeds before and after experiment.

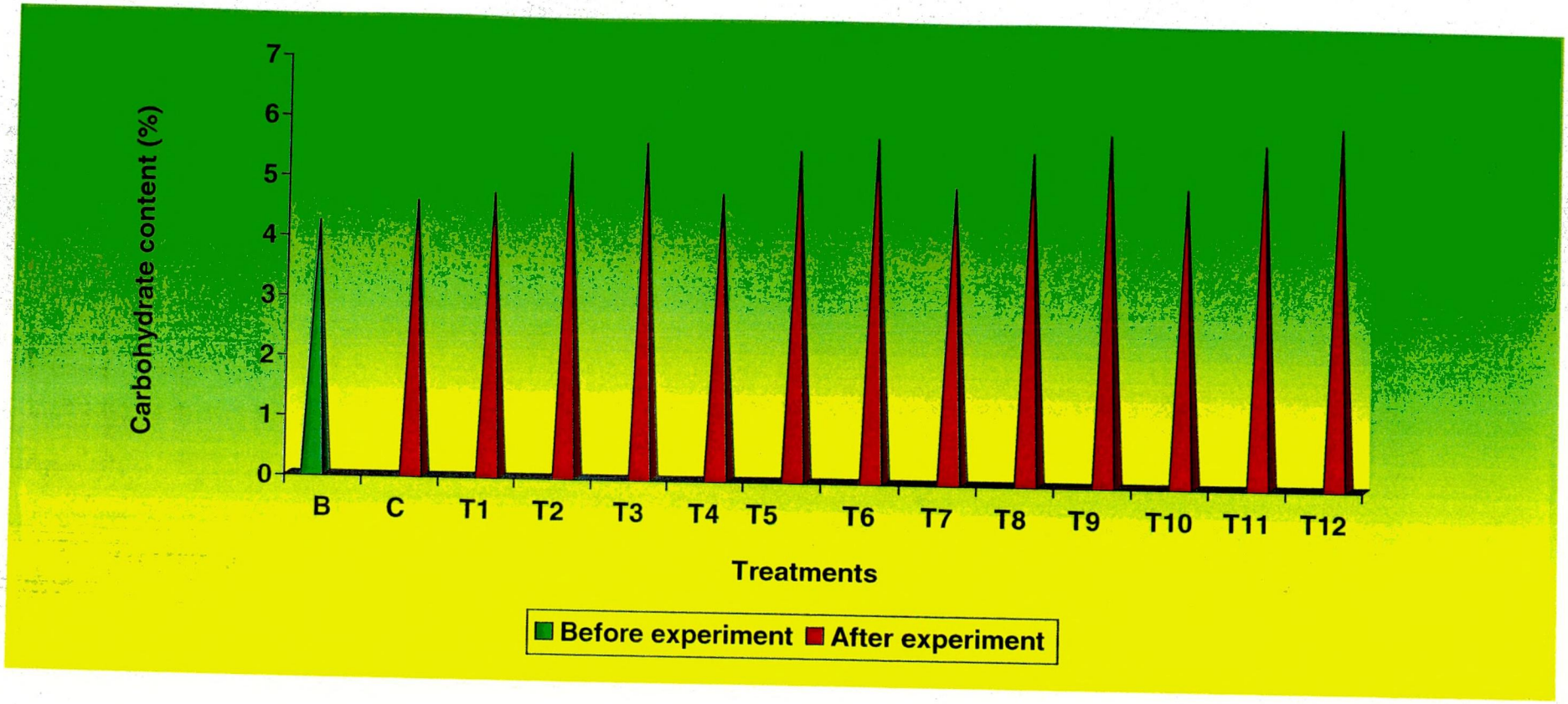

Figure - 3

Carbohydrate content (%) in the muscle tissues of *Catla catla* in the control, plant and animal wastes supplemented feeds before and after experiment.

Figure - 4

Fat content (%) in the muscle tissues of *Catla catla* in the control, plant and animal wastes supplemented feeds before and after experiment.

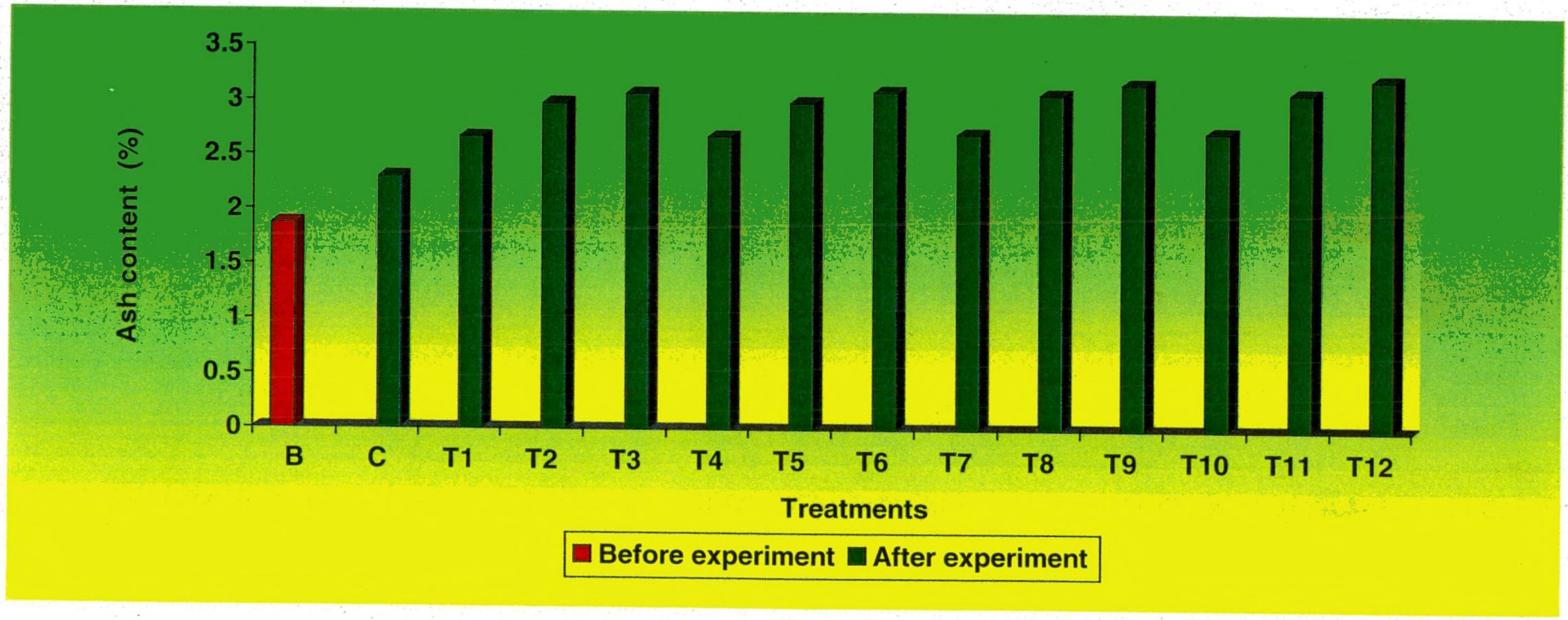

Figure - 5

Ash content (%) in the muscle tissues of *Catla catla* in the control, plant and animal wastes supplemented feeds before and after experiment.

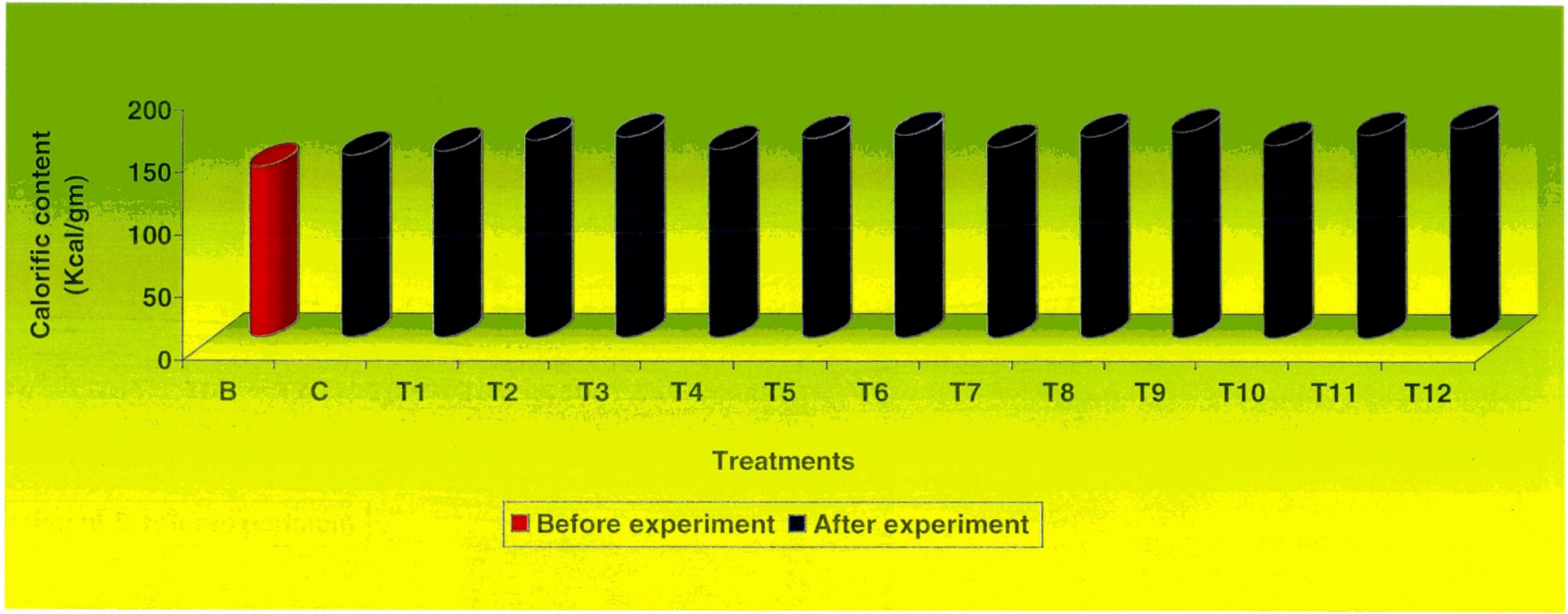

Figure - 6

Calorific content (kcal/gm) in the muscle tissues of *Catla catla* in the control, plant and animal wastes supplemented feeds before and after experiment.

4.2 PHASE - 2

PROBIOTIC SUPPLEMENTATION

4.2.1 Nutritional assessment

Protein, carbohydrate and fat contents were estimated in the control and probiotics (Sporlac®, Provisacc®, Bioboost® and Eubioz®) incorporated feeds prepared for the present study and are shown in Table 7.

Probiotics incorporation improved the protein, carbohydrate and fat contents in all the experimental feeds (T_1-T_{12}) than the control feed, which was prepared from rice bran and groundnut oil cake (1:1 ratio). Among the different probiotics supplemented feeds highest protein (35.58%), carbohydrate (13.46%) and fat contents (14.93%) were recorded inT_{12} feed prepared from 3% Eubioz® and 97% rice bran and groundnut oilcake. The lowest protein, carbohydrate and fat contents were estimated in the control feed than the other experimental feeds and the contents analysed were 34.12, 12.81 and 14.01% respectively. Fishes exposed to different probiotic supplemented diets varies significantly (P<0.05) in their protein, carbohydrate and fat content values.

4.2.2 Growth parameters

Weight gain, length gain and specific growth rate (weight and length) of the control and experimental fishes during different days (15, 30, 45 and 60) of the experimental period are given in Tables 8 to12.

Weight gain

Table 8 revealed the percentage weight gain in *C.catla* during 15 days intervals upto 60 days of the experiment. The results showed that of all the different treatments (T_1-T_{12}) and control, maximum weight gain (28.50, 56.17, 76.98 and 95.24%) was recorded in *C.catla* fed with T_{12} diet and minimum weight gain (12.06, 21.51, 36.18 and 43.16%) was recorded in the control fishes. The difference in weight gain observed in *C.catla* fed with probiotics supplemented diets during different days of the experiment was found to be statistically significant ($P<0.05$) when compared with control.

Length gain

Length gain in *C.catla* fed with control and probiotic supplemented feeds during different days of the experiment is given in Table 9. During different days of the experiment, there was an increase in net length gain in all the probiotics supplemented diet fed fishes than the control fishes. However, the maximum length gain (18.02, 47.41, 86.01 and 107.98%) was obtained in 3% Eubioz® incorporated diet fed fishes and minimum length gain was recorded in the control fishes on 15, 30, 45 and 60 days of the experiment. The minimum values recorded were 8.11, 14.19, 17.27 and 27.76%. Fishes fed with different experimental feeds differs significantly ($P<0.05$) in their length gain than the control fishes.

Specific growth rate

Table 10 and 11 showed specific growth rate (weight and length) in *C.catla* grown in control and different probiotics during different days of the experiment. Specific growth rate (weight) on 15, 30, 45 and 60 days of the experiment was maximum (0.89, 1.33, 1.56 and 1.84% respectively) in *C.catla* grown in T_{12} feed and minimum values (0.26, 0.69, 1.15 and 1.18%) were observed in fishes fed with rice bran and groundnut oilcake.

Specific growth rate (length) during 15, 30, 45 and 60 days of the experiment was highest (0.73, 1.37, 1.80 and 2.08%) in T_{12} diet fed fishes, whereas lowest (0.29, 0.51, 0.75 and 1.18%) was obtained in control fishes. Specific growth rate (weight and length) noticed in *C.catla* fed with different probiotic feed showed significantly ($P<0.05$) higher values during different days of the experiment.

4.2.3 Biochemical composition

Water content, protein, carbohydrate, fat, ash and calorific content in the muscle tissues of *C.catla* fed with control feed and different probiotics supplemented feeds were estimated before and after of the experiment and are given in Figures 7 to 12.

Protein, carbohydrate and fat contents recorded in the muscle tissues of experimental fishes before experiment were found to be 17.62, 4.53 and 2.45% respectively. After 60 days feeding of the experimental diets, fishes grown in different treatments showed better protein, carbohydrate and fat content values. Of all the different treatments T_{12} fishes obtained maximum values of protein (19.93%), carbohydrate (6.24%) and

fat contents (3.45%), whereas minimum values of 18.58, 4.85 and 2.73% were analysed in the control fishes.

Before starting of supplementary feeding calorific content estimated in *C.catla* was 139.14 Kcal/gm. After the experimental period calorific content was increased in all the experimental fishes and maximum value (170.78 Kcal/gm) was noticed in T_{12} fishes and the minimum calorific content (150.61 Kcal/gm) was noticed in the control fishes.

71.73 and 1.92% of water and ash contents were observed in the muscle tissues of experimental fishes before experimental period. On 60^{th} day of the experiment T_{12} fishes showed highest water and ash contents (77.63 and 3.14%) and lowest values of 72.75 and 2.33% were noticed in the control fishes than the other treatments.

After the experimental period Euboiz® (containing mixed cultures of bacteria and yeast) boosted highest muscle proximate composition, followed by Bioboost®, Provisacc® and Sporlac®. Fishes exposed to different experimental diets vary significantly ($P< 0.05$) in their muscle biochemical composition when compared with control.

4.2.4 Feed utilization efficiencies

Feed utilization efficiencies in terms of feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV) and feed efficiency (FE) of *C.catla* fingerlings grown in the control and different supplemented diets were analysed after 60 days of the experimental period and are summarized in Table 12.

Feed conversion ratio

Feed conversion ratio in *C.catla* fed with different probiotic supplementation at the end of the experimental period showed a variation between 1.48 to 2.156%. Among the different treatments and control, maximum feed conversion ratio (2.21%) was recorded in *C.catla* grown in the control and minimum (1.48%) was recorded in fishes fed with 3% Eubioz® supplemented diet. Feed conversion ratio recorded in all the different treatments was lower than the control and the values were found to be statistically significant ($P<0.05$).

Protein efficiency ratio

Protein efficiency ratio of *C.catla* ranged between 2.014 to 2.68% in the twelve different probiotics treatments after experiment. Highest protein efficiency ratio (2.68%) was recorded in T_{12} fishes and lowest (1.71%) was noticed in fishes grown in control feed. The difference in protein efficiency ratio found among fishes of different treatments was found to be statistically significant ($P<0.05$).

Protein productive value

Probiotics incorporated diet fed fishes showed significantly ($P<0.05$) higher protein productive value ranged between 3.72 to 6.22% than the control fishes (3.11%). Of all the different treatments maximum protein productive value (6.21%) was recorded in *C.catla* grown in T_{12} feed and lowest (3.11%) was obtained in the control fishes. Fishes exposed to different experimental feeds differ significantly ($P<0.05$) in their protein productive values.

Feed efficiency

Feed efficiency of *C.catla* was varied from 24.11 to 62.82% in the control and twelve different treatments. Probiotics incorporation improved the feed efficiency of experimental fishes than the control. The maximum feed efficiency (62.82%) was observed in T_{12} fishes and minimum (24.11%) was recorded in fishes grown in control. When compared to control significant ($P<0.05$) feed efficiency values were found in the fishes fed with different probiotics incorporated feeds.

TABLE - 7

Protein, carbohydrate and fat contents (%) in the control and probiotic supplemented feeds.

Feed	Treatments	Concentrations (%)	Protein	Carbohydrate	Fat
Control	C	---	34.12	12.81	14.01
Sporlac®	T_1	1	35.14	13.01	14.31
	T_2	2	35.40	13.11	14.46
	T_3	3	35.42	13.21	14.51
Provisacc®	T_4	1	35.15	13.07	14.41
	T_5	2	35.43	13.12	14.50
	T_6	3	35.52	13.34	14.72
Bioboost®	T_7	1	35.40	13.11	14.50
	T_8	2	35.47	13.25	14.63
	T_9	3	35.54	13.41	14.73
Eubioz®	T_{10}	1	35.46	13.25	14.63
	T_{11}	2	35.54	13.36	14.87
	T_{12}	3	35.58	13.46	14.93
SED			0.0133	0.0050	0.0054
CD (0.05)			0.0274	0.0102	0.0110

Values are the mean of three replicates

TABLE - 8

Weight gain (%) in *Catla catla* during different days of the experiment in the control and probiotic supplemented feeds.

Feed	Treatments	Concentrations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	12.06	21.51	36.18	43.16
Sporlac®	T_1	1	17.66	36.80	54.09	67.13
	T_2	2	18.36	39.50	60.66	74.26
	T_3	3	21.17	41.24	70.57	79.32
Provisacc®	T_4	1	18.70	38.45	58.92	72.51
	T_5	2	20.93	41.55	67.96	81.68
	T_6	3	24.15	44.38	69.98	84.35
Bioboost®	T_7	1	19.43	46.34	61.13	80.83
	T_8	2	22.45	48.17	70.64	86.35
	T_9	3	27.84	50.04	76.33	90.25
Eubioz®	T_{10}	1	22.06	49.24	66.14	86.51
	T_{11}	2	26.14	53.04	74.74	92.92
	T_{12}	3	28.50	56.17	76.98	95.24
SED			0.0081	0.0166	0.0245	0.0302
CD (0.05)			0.0167	0.0341	0.0504	0.0621

Values are the mean of three replicates

TABLE - 9

Length gain (%) in *Catla catla* during different days of the experiment in the control and probiotic supplemented feeds.

Feed	Treatments	Concentrations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	8.11	14.19	17.27	27.76
Sporlac®	T_1	1	11.16	19.42	34.66	42.99
	T_2	2	13.53	27.60	70.42	90.67
	T_3	3	14.27	32.25	72.82	92.38
Provisacc®	T_4	1	11.24	24.18	36.45	45.89
	T_5	2	14.31	36.02	72.82	93.15
	T_6	3	16.30	44.57	74.51	95.84
Bioboost®	T_7	1	13.73	28.09	37.68	49.81
	T_8	2	15.55	42.52	72.91	93.81
	T_9	3	17.01	45.42	77.12	96.07
Eubioz®	T_{10}	1	14.11	30.52	44.12	59.22
	T_{11}	2	17.15	44.42	82.81	98.21
	T_{12}	3	18.02	47.41	86.01	107.98
SED			0.0053	0.0131	0.0238	0.0301
CD (0.05)			0.0110	0.0270	0.0488	0.0618

Values are the mean of three replicates

TABLE - 10

Specific growth rate in percentage (weight) in *Catla catla* during different days of the experiment in the control and probiotic supplemented feeds.

Feed	Treat ments	Concent rations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.26	0.69	1.15	1.18
Sporlac®	T_1	1	0.57	1.10	1.33	1.58
	T_2	2	0.60	1.18	1.37	1.66
	T_3	3	0.66	1.19	1.53	1.69
Provisacc®	T_4	1	0.61	1.14	1.35	1.59
	T_5	2	0.65	1.20	1.41	1.72
	T_6	3	0.78	1.20	1.49	1.73
Bioboost®	T_7	1	0.63	1.21	1.39	1.69
	T_8	2	0.77	1.22	1.52	1.76
	T_9	3	0.87	1.25	1.55	1.82
Eubioz®	T_{10}	1	0.75	1.23	1.40	1.78
	T_{11}	2	0.86	1.28	1.54	1.83
	T_{12}	3	0.89	1.33	1.56	1.84
SED			0.0003	0.0004	0.0006	0.0006
CD (0.05)			0.0006	0.0009	0.0011	0.0013

Values are the mean of three replicates

TABLE - 11

Specific growth rate in percentage (length) in *Catla catla* during different days of the experiment in the control and probiotic supplemented feeds.

Feed	Treat ments	Concent rations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.29	0.51	0.75	1.18
Sporlac®	T_1	1	0.41	0.02	1.23	1.40
	T_2	2	0.51	1.10	1.70	1.60
	T_3	3	0.53	1.15	1.72	1.62
Provisacc®	T_4	1	0.49	1.03	1.26	1.42
	T_5	2	0.54	1.16	1.73	1.99
	T_6	3	0.69	1.28	1.75	2.02
Bioboost®	T_7	1	0.52	1.11	1.33	1.45
	T_8	2	0.67	1.19	1.74	2.02
	T_9	3	0.71	1.31	1.77	2.05
Eubioz®	T_{10}	1	0.52	1.12	1.35	1.54
	T_{11}	2	0.72	1.23	1.78	2.06
	T_{12}	3	0.73	1.37	1.80	2.08
SED			0.0002	0.0006	0.0006	0.0007
CD (0.05)			0.0005	0.0013	0.0014	0.0015

Values are the mean of three replicates

TABLE - 12

Feed utilization efficiencies (%) of *Catla catla* in the control and probiotic supplemented feeds.

Feed	Treatments	Concentrations (%)	FCR	PER	PPV	FE
Control	C	---	2.21	1.71	3.11	24.11
Sporlac®	T_1	1	2.16	2.01	3.72	43.02
	T_2	2	1.84	2.29	4.51	48.01
	T_3	3	1.71	2.32	4.90	52.31
Provisacc®	T_4	1	2.13	2.13	3.83	44.72
	T_5	2	1.82	2.47	4.68	50.80
	T_6	3	1.62	2.48	5.02	56.72
Bioboost®	T_7	1	2.01	2.21	4.06	46.45
	T_8	2	1.60	2.48	4.62	55.37
	T_9	3	1.58	2.50	5.73	59.10
Eubioz®	T_{10}	1	1.93	2.25	4.47	49.81
	T_{11}	2	1.59	2.52	5.02	58.11
	T_{12}	3	1.48	2.68	6.21	62.82
SED			0.0007	0.0009	0.0018	0.0191
CD (0.05)			0.0014	0.0018	0.0036	0.0392

Values are the mean of three replicates

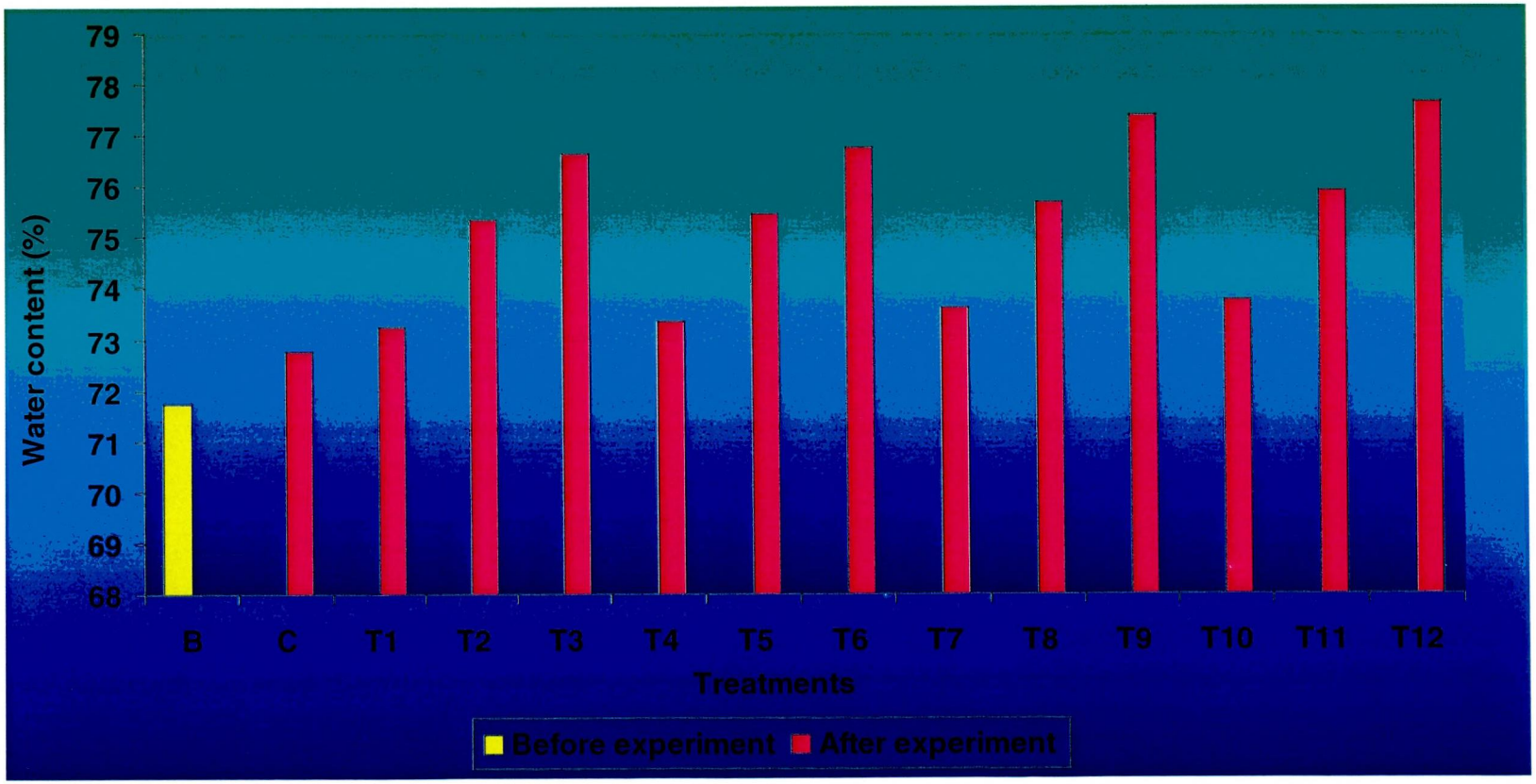

Figure - 7

Water content (%) in the muscle tissues of *Catla catla* in the control and probiotic supplemented feeds before and after experiment.

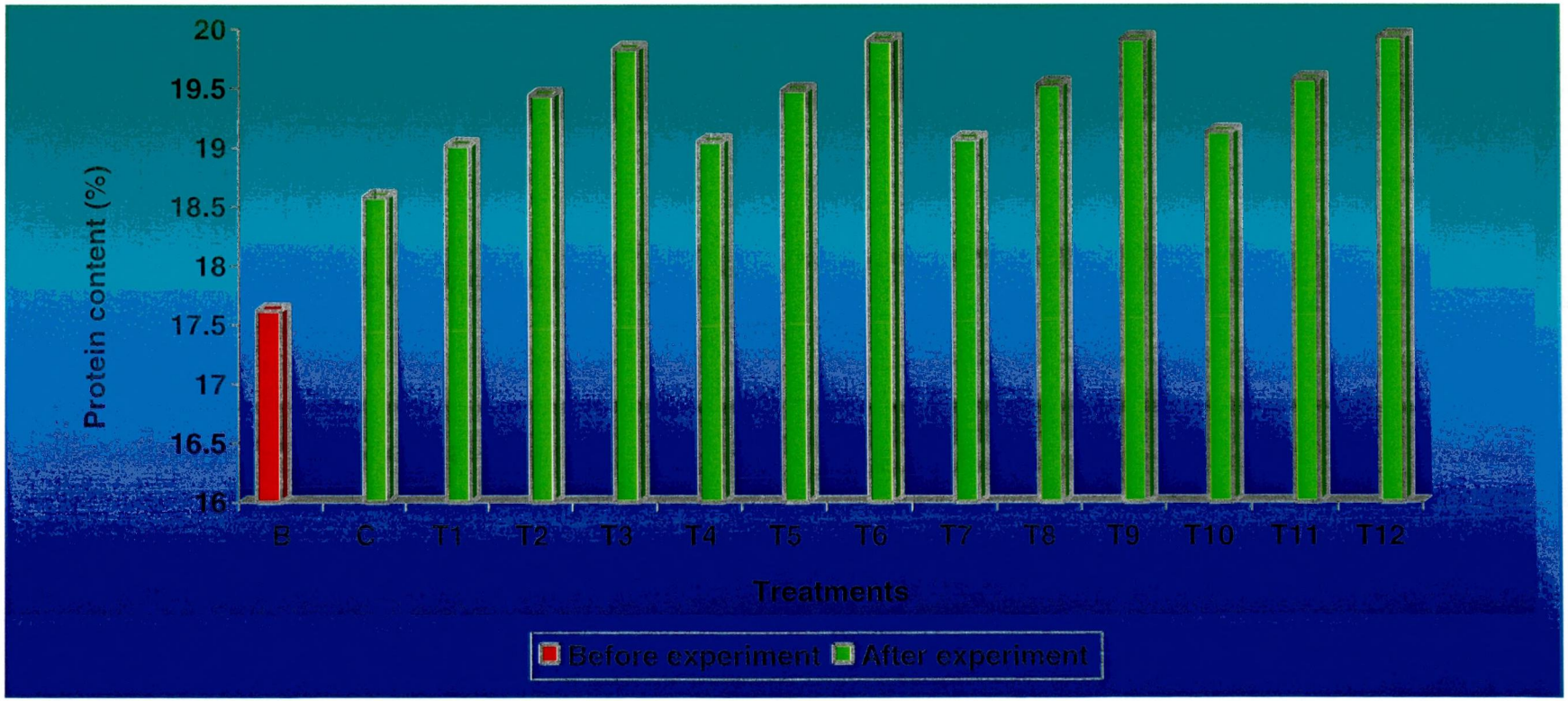

Figure - 8

Protein content (%) in the muscle tissues of *Catla catla* in the control and probiotic supplemented feeds before and after experiment.

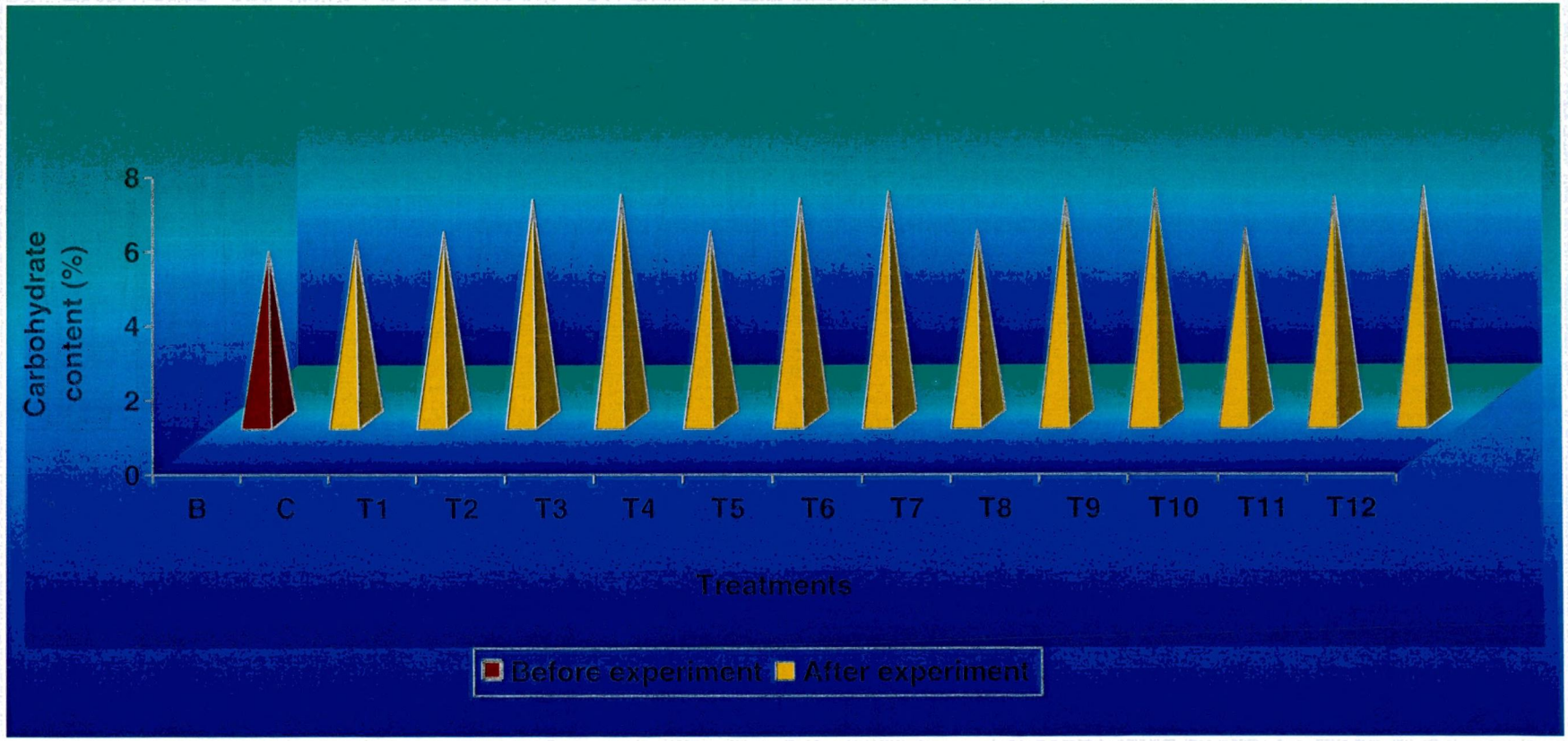

Figure - 9

Carbohydrate content (%) in the muscle tissues of *Catla catla* in the control and probiotic supplemented feeds before and after experiment.

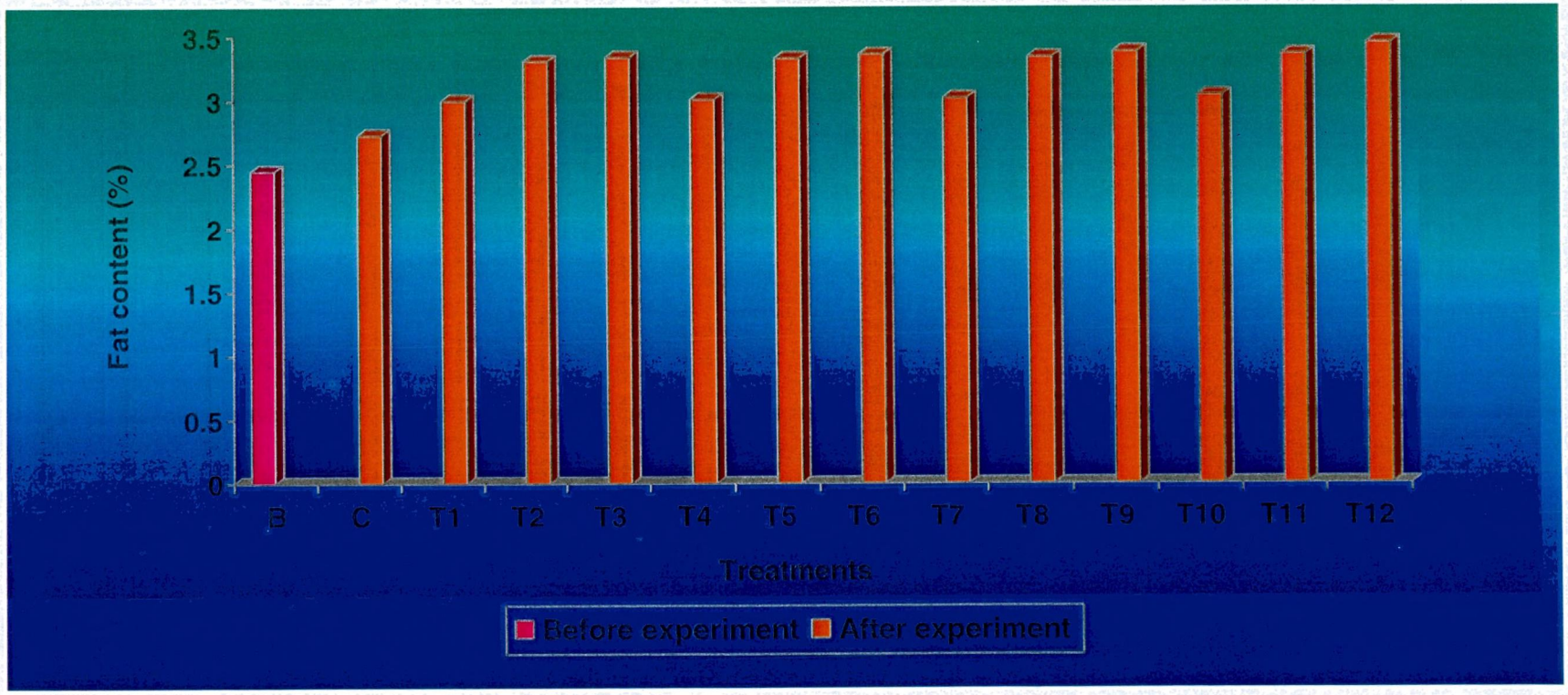

Figure - 10

Fat content (%) in the muscle tissues of *Catla catla* in the control and probiotic supplemented feeds before and after experiment.

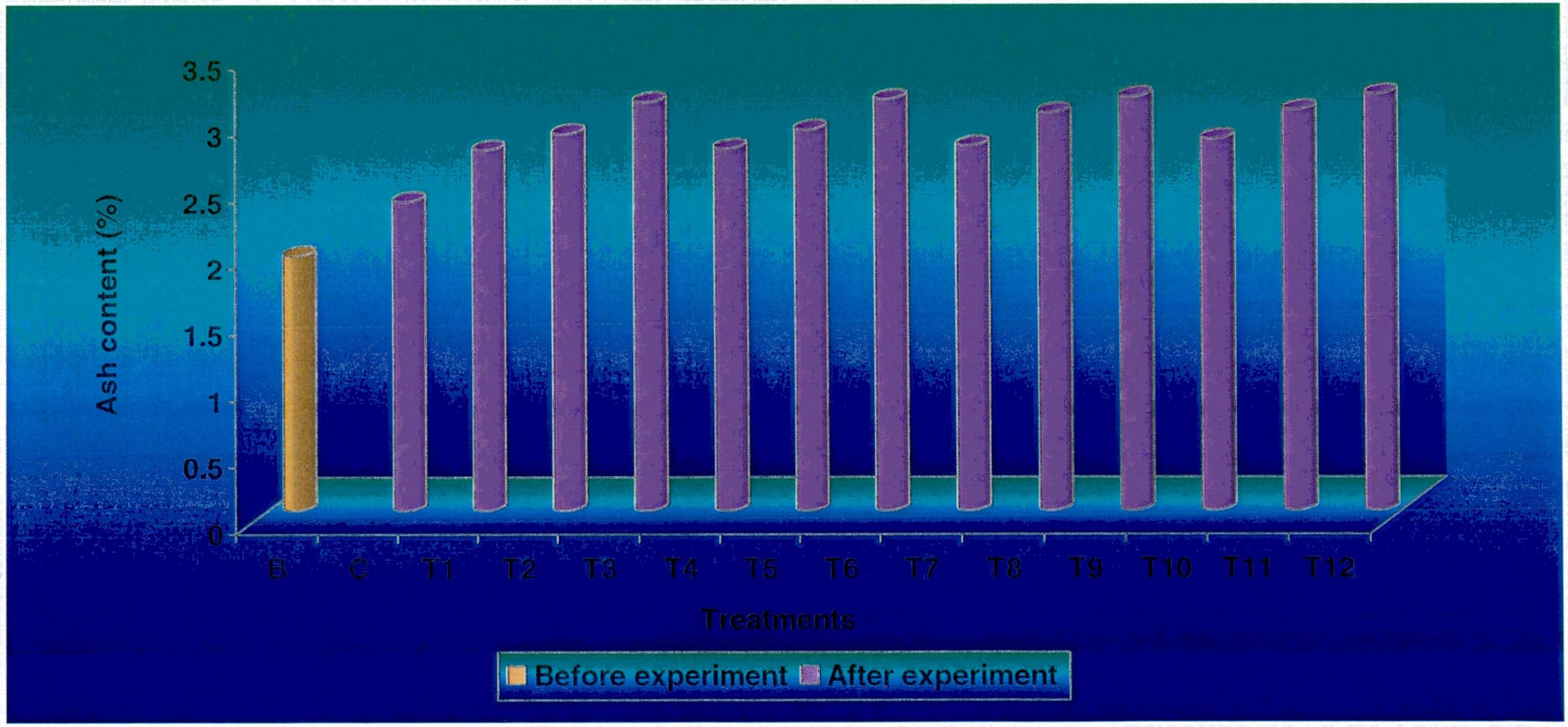

Figure - 11

Ash content (%) in the muscle tissues of *Catla catla* in the control and probiotic supplemented feeds before and after experiment.

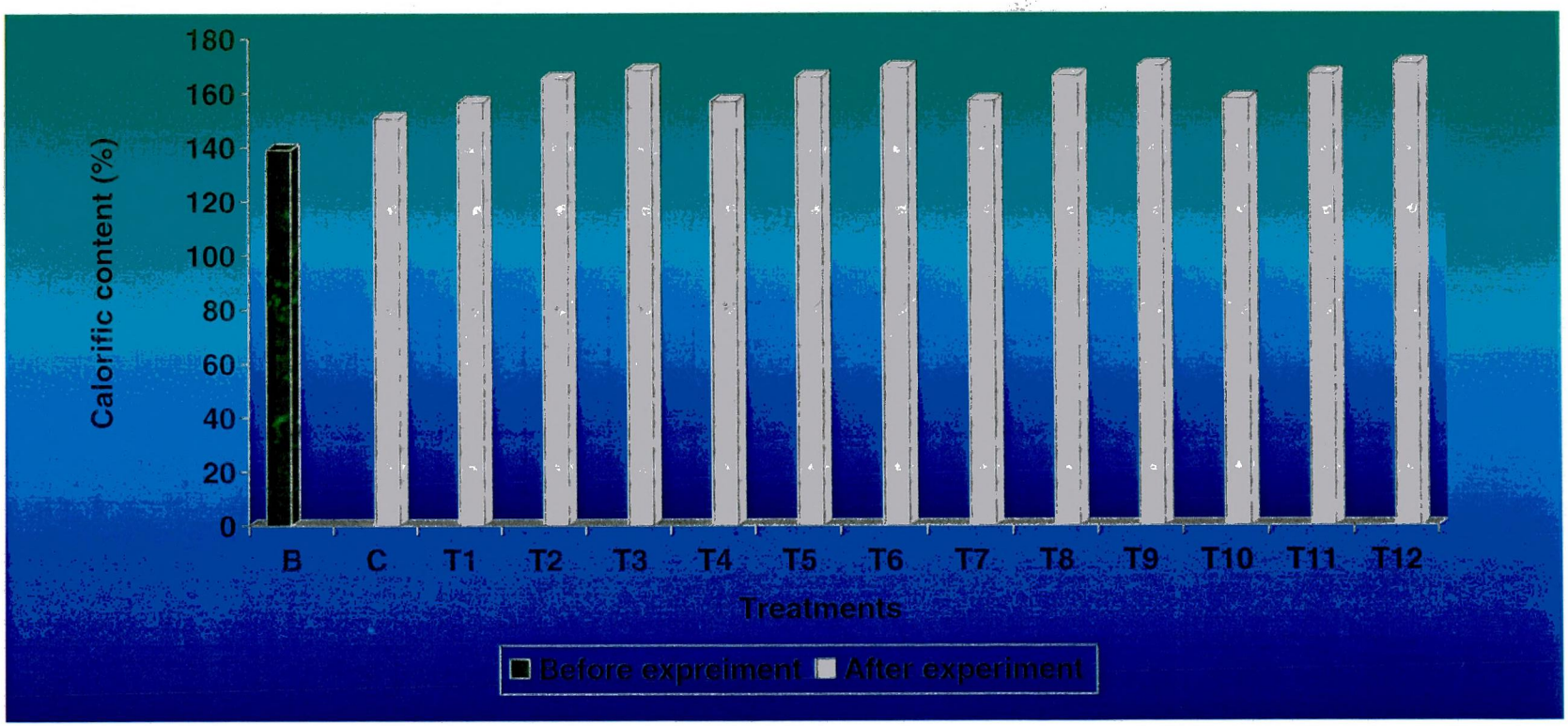

Figure - 12

Calorific content (kcal/gm) in the muscle tissues of *Catla catla* in the control and probiotic supplemented feeds before and after experiment.

4.3 PHASE - 3

MEDICINAL HERBS SUPPLEMENTATION

4.3.1 Nutritional assessment

Proximate composition such as protein, carbohydrate and fat contents in the control and six different experimental feeds prepared for the present experiment were estimated and are presented in Table 13.

Medicinal herbs incorporated feeds (T_1-T_6) contain higher protein, carbohydrate and fat contents than the control feed. *P.emblica* incorporated feed contains higher percentage of protein, carbohydrate and fat contents than the *C.dactylon* Included feed. Of all the different feeds, maximum protein, carbohydrate and fat contents (35.55, 14.15 and 14.29%) were recorded in T_6 feed, prepared from 15% *P.emblica* and 85% rice bran and groundnut oil cake. The minimum protein (34.12%), carbohydrate (12.81%) and fat contents (14.01%) were estimated in the control feed, prepared from rice bran and groundnut oil cake (1:1 ratio). All the experimental diets prepared from *C.dactylon* and *P.emblica* showed higher protein, carbohydrate and fat contents than the control feed and the values were found to be statistically significant ($P<0.05$).

Growth parameters

Weight gain

Table 14 revealed weight gain in *C.catla* during different days of the experiment in the control and six different treatments.

C.dactylon and *P.emblica* incorporated feeds boosted weight gain in the experimental fishes than the control feed. However, the maximum weight gain (20.39, 36.17, 61.01 and 74.68%) was recorded in T_5 fishes fed with 10% *P.emblica* and minimum weight gain (12.01, 22.18, 34.88 and 40.13%) was observed in control diet fed fishes during 15, 30, 45 and 60 days of the experiment. The difference in weight gain noticed in *C.catla* in six different treatments was found to be statistically significant ($P<0.05$) when compared with control.

Length gain

Length gain in *C.catla* during different days of the experiment in the control and six different treatments are shown in Table 15. Both *C.dactylon* and *P.emblica* supplemented feed improved the length gain in experimental fishes than the control diet. Among the different treatments, the maximum length gain (13.62, 29.52, 62.02 and 84.22%) was recorded in T_5 fishes and minimum length gain (8.95, 12.12, 17.28 and 26.98%) was noticed in the control fishes. Length gain recorded in the experimental fishes when analysed statistically, the values were found to be statistically significant ($P<0.05$).

Specific growth rate

Table 16 and 17 showed specific growth rate (weight and length) in *C.catla* in the control and six different treatments during different days of the experiment. During 15, 30, 45 and 60 days of the experiment, among the six different treatments and control, *C.catla* grown in T_5 feed exhibited significantly highest specific growth rate (weight) (0.75, 1.26, 1.53 and 1.72%) and

C.catla grown in control feed showed lowest specific growth rate (weight) (0.25, 0.70, 1.14 and 1.27%) than the other treatments.

Likewise, highest specific growth rate (length) (0.61, 1.28, 1.85 and 1.96%) was obtained in T_5 treatment fishes and lowest specific growth rate (length) (0.28, 0.51, 0.74 and 1.12%) was noticed in the control fishes on 15, 30, 45 and 60 of the experiment. The difference in specific growth rate (weight and length) values were found to be statistically significant ($P<0.05$) in fishes fed with different experimental diets.

Biochemical composition

Water content

Figure 13 showed the percentage of water content in the muscle tissues of *C.catla* before and after experiment. Before experiment, water content recorded in the muscle tissues of *C.catla* was 71.16%. After 60 days feeding of medicinal herbs supplemented feed, the highest water content (77.04%) was recorded in T_5 fishes, followed by T_6 (76.88%), T_2 (75.83%), T_3 (75.69%), T_4 (72.64%) and T_1 (72.58%), whereas the lowest water content (72.27%) was obtained in the control fishes.

Protein

Protein content estimated in the muscle tissues of *C.catla* grown in the control and different treatments before and after the experiment are presented in Figure 14. Before experiment, protein content estimated in the fishes was 17.51%. After the experimental period of 60 days, fishes fed with 10% *P.emblica* supplemented diet showed the highest protein content (19.76%), followed by T_6 (19.54%), T_2 (19.17%), T_3 (19.11%),

T_4 (18.81%) and T_1 (18.80%). Fishes grown in the control feed showed lowest protein content of 18.53%.

Carbohydrate

Figure 15 indicates that carbohydrate content in the muscle tissues of *C.catla* before experiment was 4.44%. After 60 days feeding of medicinal herbs, fishes grown in T_5 feed obtained maximum carbohydrate content (6.10%), followed by T_2 (6.05%), T_6 (5.92%), T_3 (5.86%), T_4 (4.88%) and T_1 (4.84%). The minimum carbohydrate content of 4.77% was observed in the control feed fed fishes.

Fat

At the beginning of the experiment fat content recorded in the muscle tissues of *C.catla* was 2.48% (Figure 16). At the end of the experiment, highest fat content (3.40%) was noticed in fishes fed with T_5 diet, followed by T_6 (3.34%), T_2 (3.22%), T_3 (3.19%), T_4 (2.98%) and T_1 (2.97%). Fishes grown in the control feed showed minimum fat content (2.75%) than the other treatments.

Ash

Figure 17 showed ash content in the muscle tissues of *C.catla* in the control and six different treatments before and after experiment. Before the experimental period, ash content estimated in *C.catla* was 1.95%. After 60 days of the experimental period, T_5 fishes exhibited highest percentage fat content (3.10%), followed by T_6 (2.98%), T_2 (2.87%), T_3 (2.86%), T_4 (2.74%) and T_1 (2.71%), whereas lowest fat content (2.37%) was recorded in fishes grown in the control.

Calorific content

Calorific content recorded in the muscle tissues of *C.catla* at the beginning of the experiment was 135.12 Kcal/gm (Figure 18). After the experimental period, highest calorific content (168.75 Kcal/gm) was estimated in fishes grown in T_5 diet, followed by T_6 (166.28 Kcal/gm), T_2 (163.46 Kcal/gm), T_3 (162.09 Kcal/gm), T_4 (154.47 Kcal/gm) and T_1 (154.20 Kcal/gm). The minimum calorific content (150.20 Kcal/gm) was noticed in the control diet fed fishes.

Both medicinal herbs (*P.emblica* and *C.dactylon*) included feeds enhanced the muscle biochemical composition in the experimental fishes after 60 days of feeding and all these biochemical parameters when analysed statistically the results were found to be significant ($P< 0.05$).

4.3.4 Feed utilization efficiencies

Feed utilization efficiencies such as feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV) and feed efficiency (FE) were analysed and are presented in Table 18.

Feed conversion ratio

Feed conversion ratio showed significant variation ranged from 1.513 to 2.168% in the control and experimental fishes. Among the different treatments, highest feed conversion ratio (2.17%) was obtained in fishes fed with control feed, followed by T_1 (2.12%), T_4 (1.94%), T_3 (1.69%), T_2 (1.58%) and T_6 (1.57%), while the lowest feed conversion ratio (1.51%) was obtained in T_5 fishes fed with 10% *P.emblica* incorporated feed.

The difference in feed conversion ratio observed in fishes of different treatments was found to be statistically significant ($P<0.05$).

Protein efficiency ratio

Protein efficiency ratio of fishes fed with control and experimental diets varied between 1.71 to 2.38%. *C.catla* fed with T_5 feed showed highest protein efficiency ratio (2.38%), followed by T_6 (2.66%), T_2 (2.24%), T_3 (2.12%), T_4 (2.00%) and T_1 (1.98%), whereas the lowest protein efficiency ratio (1.71%) was recorded in the control diet fed fishes. Statistically significant ($P<0.05$) protein efficiency ratio was recorded in fishes fed with medicinal herbs supplemented diets.

Protein productive value

Table 12 revealed protein productive values in control and six different treatments, which ranged between 3.18 to 5.64%. *C.catla* grown in T_5 feed exhibited maximum protein productive value (5.64%), followed by T_6 (4.90%), T_2 (4.78%), T_3 (4.41%), T_4 (3.62%) and T_1 (3.44%). The minimum protein productive value (3.18%) was recorded in the control fishes. Fishes exposed to different experimental diets vary significantly ($P<0.05$) in their protein productive values.

Feed efficiency

Feed efficiency value recorded in control and six different treatments was highly varied between 23.32 to 54.62%. Of all the treatments, feed efficiency was maximum (54.615%) in fishes grown in T_5 feed, followed by T_6 (52.26%), T_2 (51.52%), T_3 (49.01%), T_4 (41.41%) and T_1 (39.22%), whereas minimum feed efficiency (23.32%) was analysed in the control fishes.

Feed efficiency values obtained in the experimental fishes were higher than the control fishes and the values were found to be statistically significant ($P< 0.05$).

TABLE - 13

Protein, carbohydrate and fat contents (%) in the control and medicinal herbs supplemented feeds.

Feed	Treatments	Concentrations (%)	Protein	Carbohydrate	Fat
Control	C	---	34.12	12.81	14.01
Cynodon dactylon	T_1	5	34.15	13.01	14.13
	T_2	10	34.36	13.21	14.15
	T_3	15	34.52	13.25	14.17
Phyllanthus emblica	T_4	5	34.23	13.19	14.21
	T_5	10	35.39	14.02	14.26
	T_6	15	35.55	14.15	14.29
SED			0.0131	0.0051	0.0054
CD (0.05)			0.0280	0.0109	0.0115

Values are the mean of three replicates

TABLE - 14

Weight gain (%) in *Catla catla* during different days of the experiment in the control and medicinal herbs supplemented feeds.

Feed	Treat ments	Concen trations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	12.01	22.18	34.88	40.13
Cynodon dactylon	T_1	5	14.97	22.93	45.25	58.12
	T_2	10	17.29	29.51	52.62	70.27
	T_3	15	17.15	27.22	51.57	67.32
Phyllanthus emblica	T_4	5	15.00	27.02	49.85	62.51
	T_5	10	20.39	36.17	61.01	74.68
	T_6	15	18.41	31.32	58.25	72.11
SED			0.0063	0.0107	0.0191	0.0241
CD (0.05)			0.0134	0.0229	0.0410	0.0517

Values are the mean of three replicates

TABLE - 15

Length gain (%) in *Catla catla* during different days of the experiment in the control and medicinal herbs supplemented feeds.

Feed	Treatments	Concentrations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	8.95	12.12	17.28	26.98
Cynodon dactylon	T_1	5	10.98	18.00	26.65	37.66
	T_2	10	12.01	28.61	52.43	75.11
	T_3	15	11.57	27.52	50.82	74.03
Phyllanthus emblica	T_4	5	11.33	19.81[e]	28.03	39.18
	T_5	10	13.62	29.52	62.02	84.22
	T_6	15	12.69	27.90	59.01	81.15
SED			0.0043	0.0091	0.0170	0.0240
CD (0.05)			0.0093	0.0194	0.0365	0.0514

Values are the mean of three replicates

TABLE - 16

Specific growth rate in percentage (weight) in *Catla catla* during different days of the experiment in the control and medicinal herbs supplemented feeds.

Feed	Treat ments	Concen trations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.25	0.70	1.14	1.27
Cynodon dactylon	T_1	5	0.41	0.74	1.30	1.50
	T_2	10	0.46	0.98	1.48	1.61
	T_3	15	0.45	0.91	1.47	1.59
Phyllanthus emblica	T_4	5	0.45	0.91	1.45	1.53
	T_5	10	0.75	1.26	1.53	1.72
	T_6	15	0.69	1.14	1.52	1.69
SED			0.0002	0.0004	0.0005	0.0008
CD (0.05)			0.0004	0.0008	0.0011	0.0017

Values are the mean of three replicates

TABLE - 17

Specific growth rate in percentage (length) in *Catla catla* during different days of the experiment in the control and medicinal herbs supplemented feeds.

Feed	Treatments	Concentrations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.28	0.51	0.74	1.16
Cynodon dactylon	T_1	5	0.40	0.83	1.15	1.32
	T_2	10	0.49	1.13	1.64	1.91
	T_3	15	0.42	1.08	1.51	1.80
Phyllanthus emblica	T_4	5	0.41	1.01	1.28	1.43
	T_5	10	0.61	1.28	1.85	1.96
	T_6	15	0.54	1.11	1.83	1.91
SED			0.0002	0.0004	0.0006	0.0008
SD (0.05)			0.0003	0.0008	0.0012	0.0017

Values are the mean of three replicates

TABLE - 18

Feed utilization efficiencies (%) of *Catla catla* in the control and medicinal herbs supplemented feeds.

Feed	Treatments	Concentrations (%)	FCR	PER	PPV	FE
Control	C	---	2.17	1.71	3.18	23.32
Cynodon dactylon	T_1	5	2.16	1.98	3.44	39.22
	T_2	10	1.58	2.25	4.78	51.52
	T_3	15	1.69	2.11	4.41	49.01
Phyllanthus emblica	T_4	5	1.94	2.00	3.62	41.41
	T_5	10	1.51	2.38	5.64	54.62
	T_6	15	1.57	2.27	4.90	52.26
SED			0.0008	0.0008	0.0016	0.0172
CD (0.05)			0.0017	0.0018	0.0034	0.0369

Values are the mean of three replicates

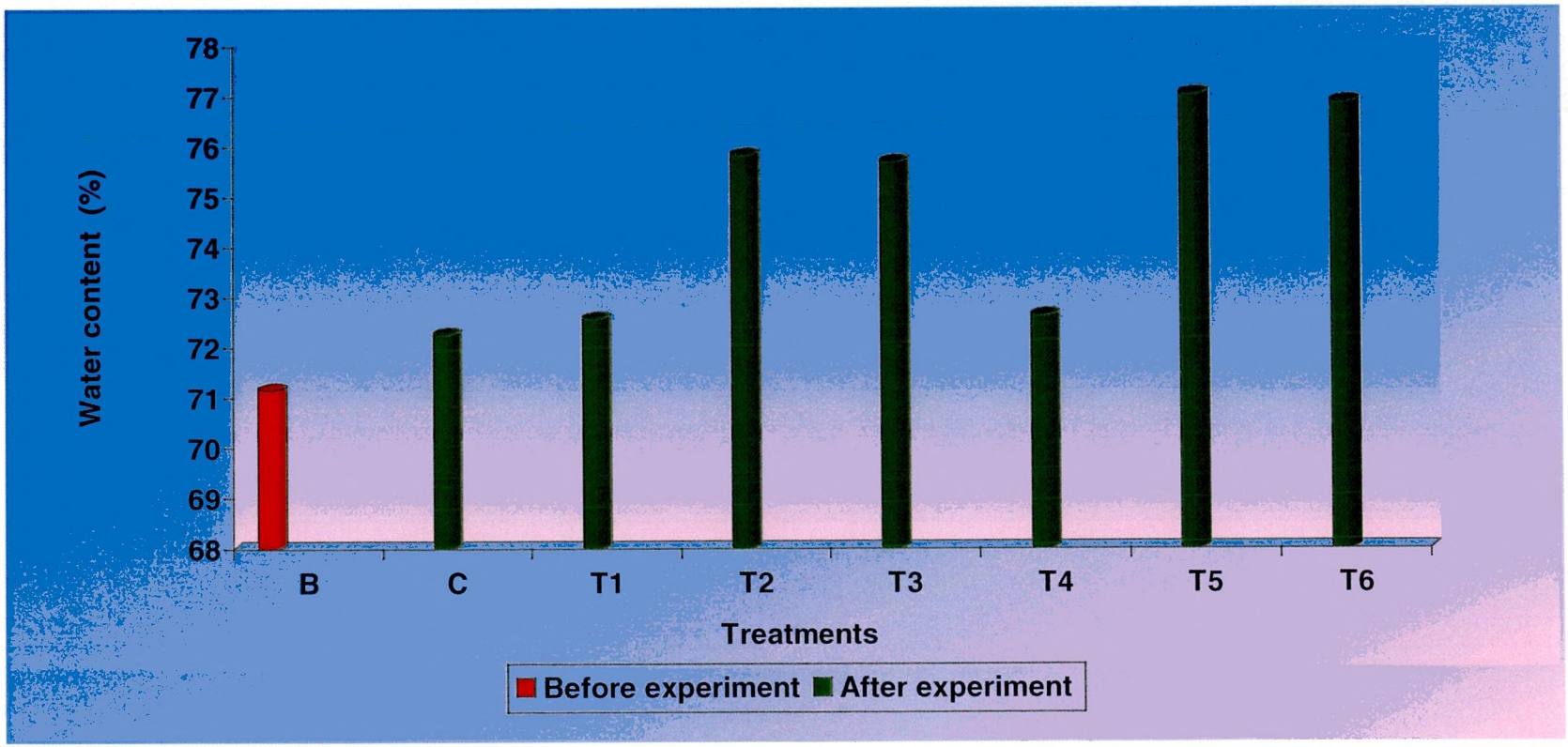

Figure - 13

Water content (%) in the muscle tissues of *Catla catla* in the control and medicinal herbs supplemented feeds before and experiment.

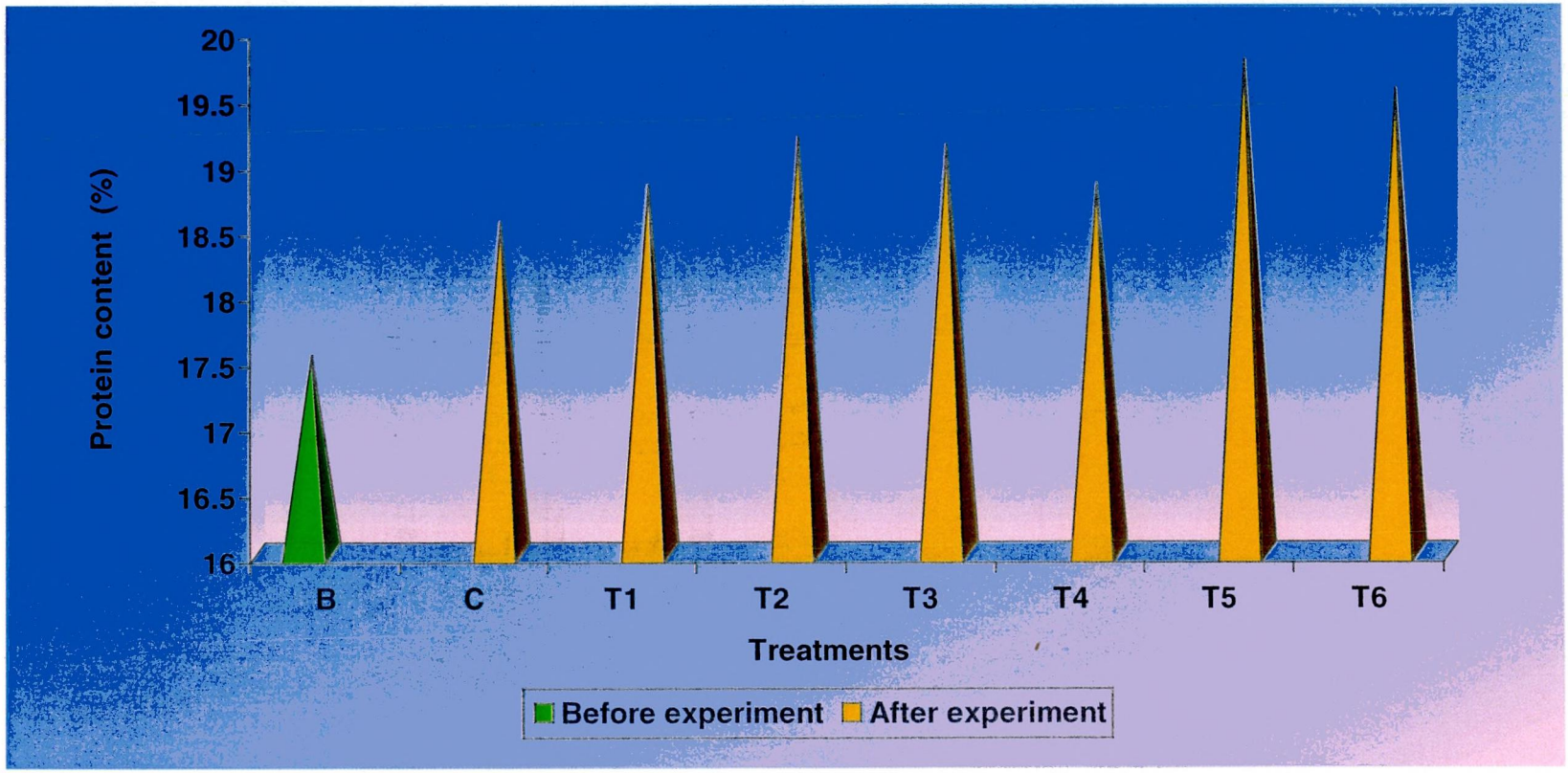

Figure - 14

Protein content (%) in the muscle tissues of *Catla catla* in the control and medicinal herbs supplemented feeds before and experiment.

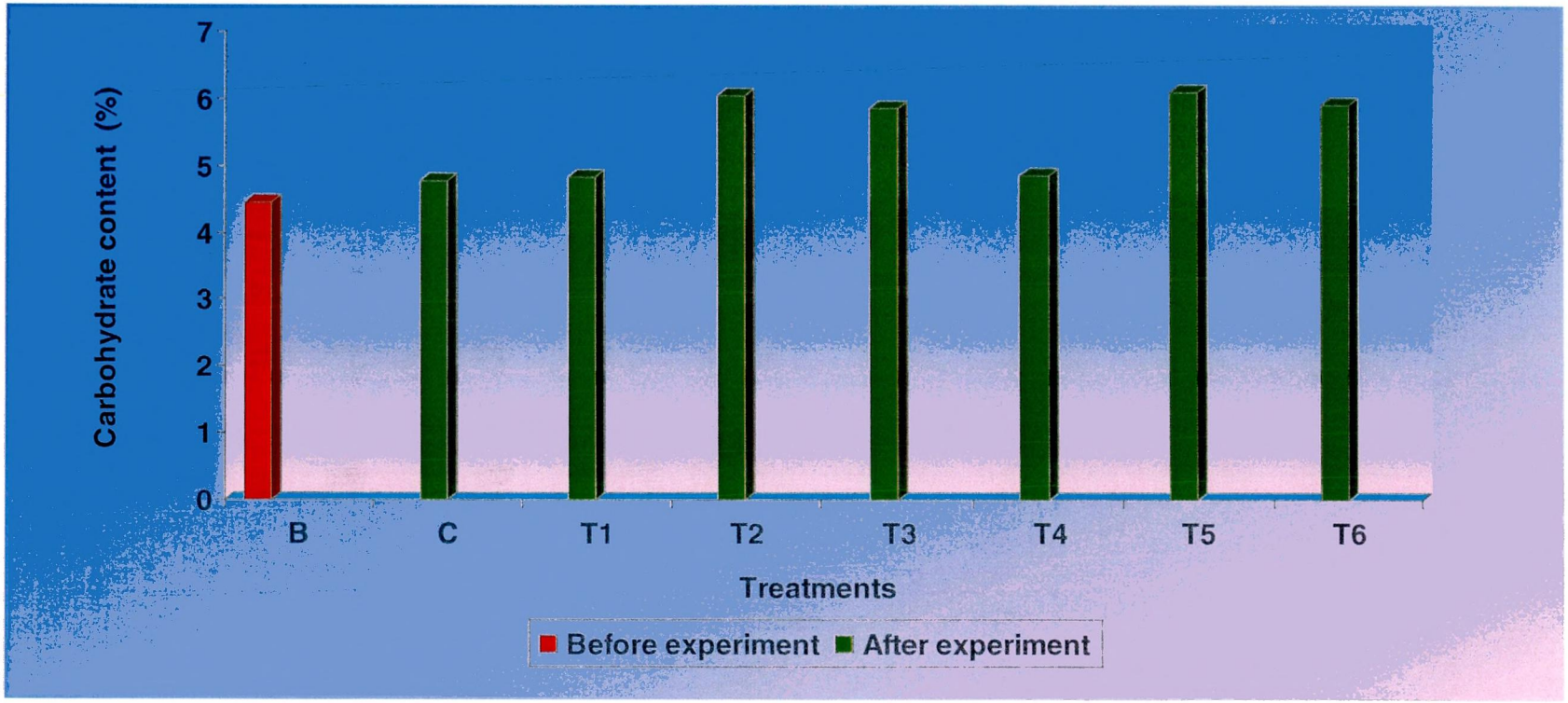

Figure - 15

Carbohydrate content (%) in the muscle tissues of *Catla catla* in the control and medicinal herbs supplemented feeds before and experiment.

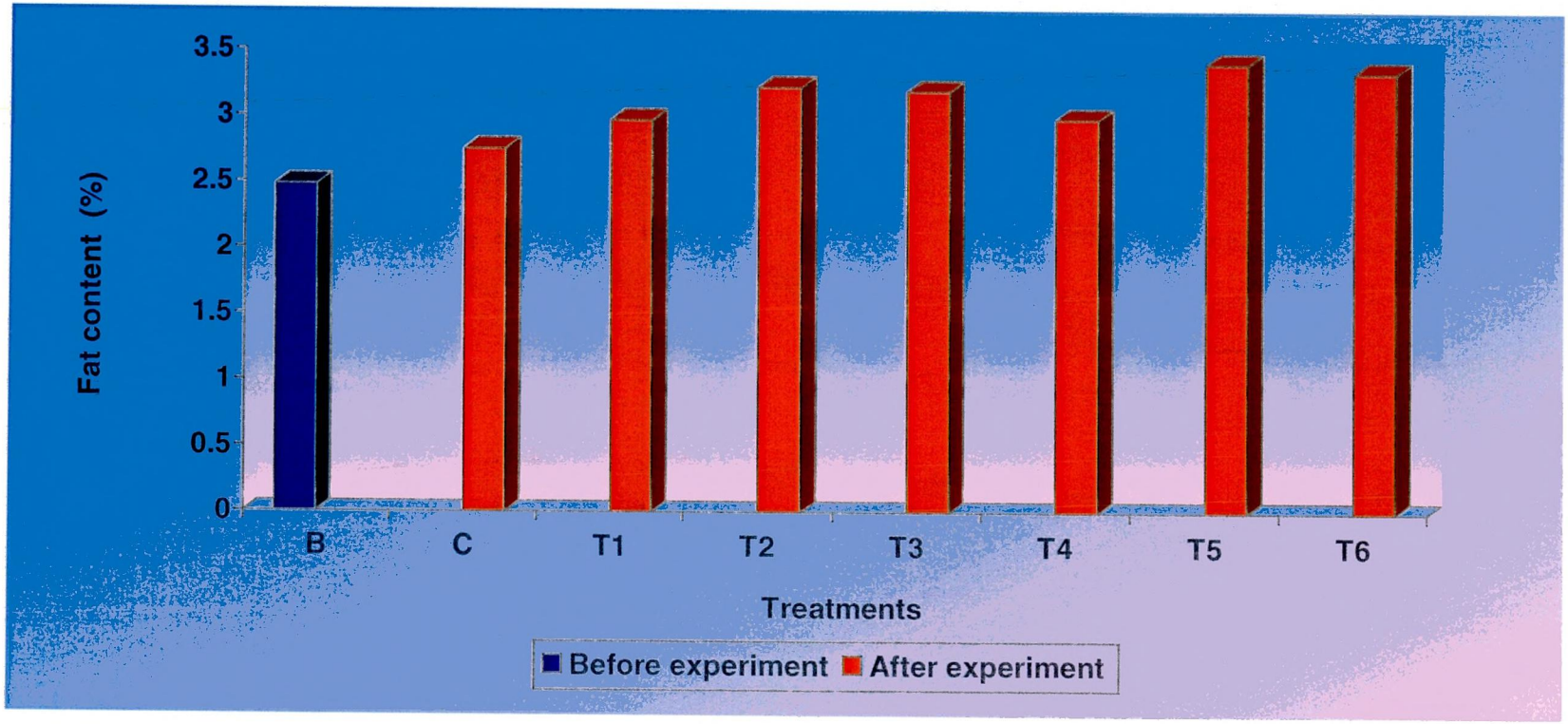

Figure - 16

Fat content (%) in the muscle tissues of *Catla catla* in the control and medicinal herbs supplemented feeds before and after experiment.

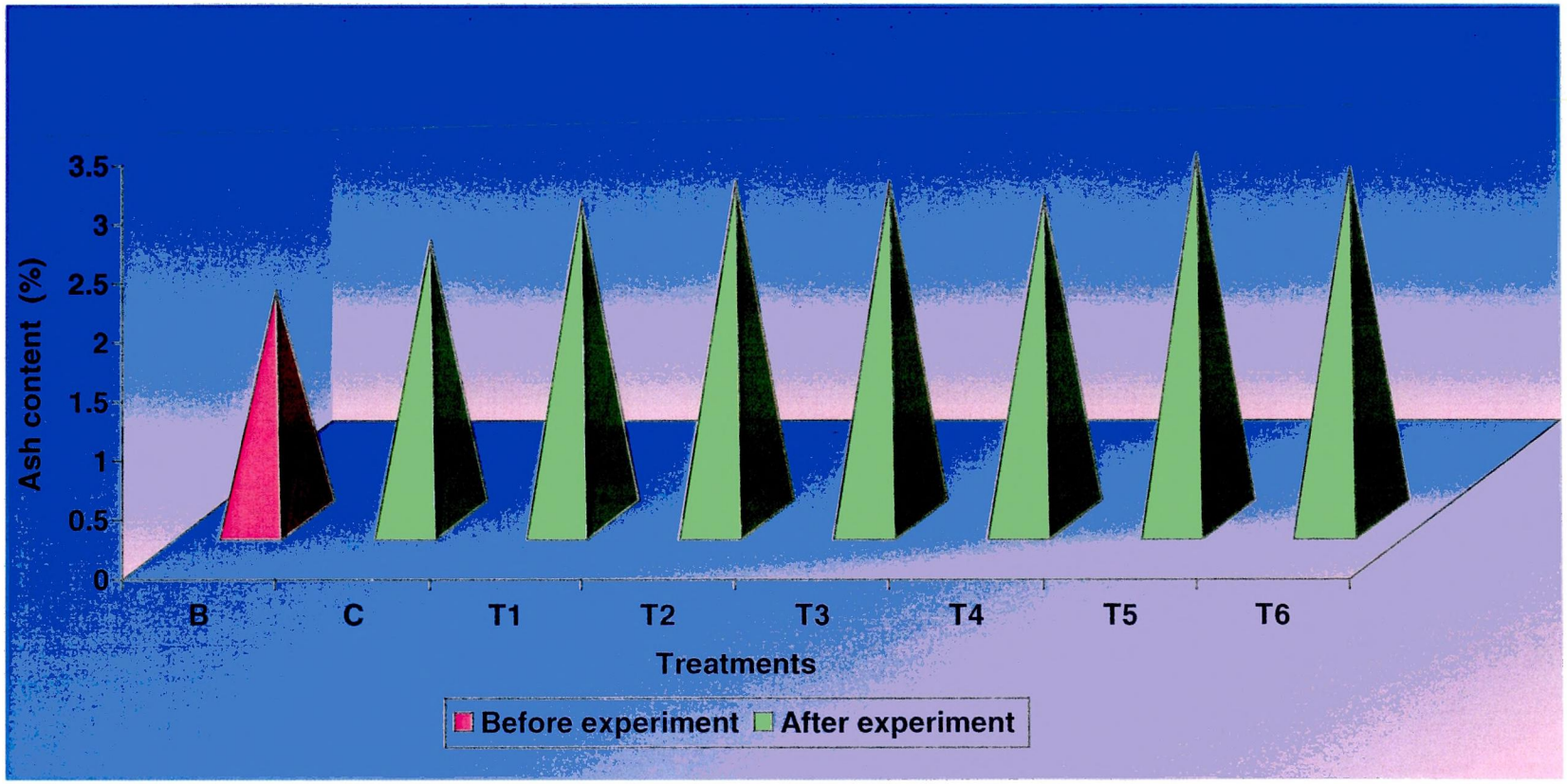

Figure - 17

Ash content (%) in the muscle tissues of *Catla catla* in the control and medicinal herbs supplemented feeds before and after experiment.

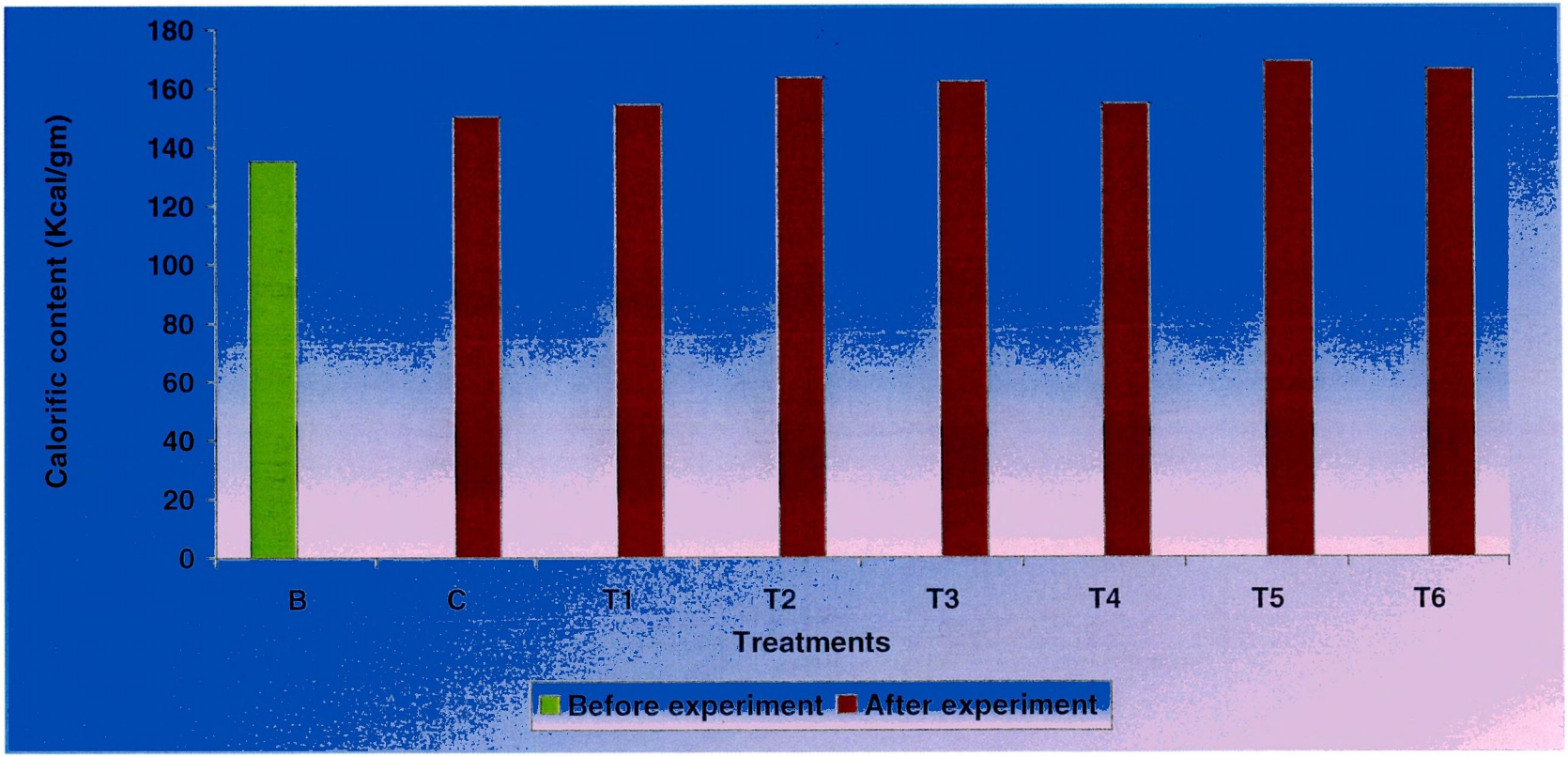

Figure - 18

Calorific content (Kcal/gm) in the muscle tissues of *Catla catla* in the control and medicinal herbs supplemented feeds before and after experiment.

4.4 PHASE- 4

VETERINARY GROWTH PROMOTERS SUPPLEMENTATION

4.4.1 Nutritional assessment

Table 19 showed protein, carbohydrate and fat contents recorded in the control and medicinal herbs supplemented feeds prepared for the present experiment.

Protein, carbohydrate and fat contents were higher in veterinary growth promoters incorporated feed than the control feed. Supplevite® supplemented feeds contain higher level of protein content than the Vimeral® supplemented feeds. Among the six different feeds prepared for the experiment protein, carbohydrate and fat contents were maximum (35.58, 13.18 and 14.50%) in T_6 feed, which was prepared from 15% Supplevite® and 85% rice bran and groundnut oil cake. The minimum protein, carbohydrate and fat contents were observed in the control feed, prepared from 1:1 ratio of rice bran and groundnut oil cake and the values estimated were 34.12, 12.82 and 14.01%. Fishes exposed to different experimental diets differ significantly ($P<0.05$) in their protein content.

4.4.2 Growth parameters

Weight gain, length gain and specific growth rate (weight and length) in *C.catla* during 15, 30, 45 and 60 days of the experiment in the control and six different treatments were studied and are presented in Tables 20 to 23.

Weight gain

Weight gain in *C.catla* during 15 days intervals upto 60 days of the experiment are shown in Table 20. All the six different experimental feeds prepared from Vimeral® and Supplevite® enhanced weight gain in the experimental fishes (T_1-T_6) than the control feed. However, during 15, 30, 45 and 60 days of the experiment highest weight gain of 19.38, 34.84, 59.03 and 73.82% was recorded in T_5 fishes and lowest weight gain (10.01, 20.23, 32.48 and 41.00%) was obtained in the control fishes. *C.catla* fed with veterinary growth promoters supplemented diets showed significant (P<0.05) weight gain than the control fishes.

Length gain

Length gain in *C.catla* during different days (15, 30, 45 and 60) of the experiment in the control and six different treatments are shown in Table 21. All the experimental diets boosted length gain in *C.catla* (T_1-T_6) than the control diet. However, length gain during 15, 30, 45 and 60 days of the experiment was maximum (10.94, 27.66, 59.57 and 80.85%) in Supplevite® supplemented diet fed fishes (T_5) and minimum length gain (8.12, 12.13, 17.46 and 24.33%) was recorded in the control fishes. Length gain recorded in the experimental fishes was higher than the control fishes and the values were found to be statistically significant (P<0.05).

Specific growth rate

Table 22 and 23 revealed specific growth rate (weight and length) in *C.catla* during 15, 30, 45 and 60 days of the experiment in the control and veterinary growth promoters supplemented

treatments. Fishes grown in six different experimental diets showed higher specific growth rate than the control fishes. Among the six different treatments, during 15, 30, 45 and 60 days of the experiment T_5 fishes showed highest specific growth rate (weight) (0.62, 1.04, 1.42 and 1.59%) and control fishes exhibited lowest values (0.22, 0.69, 1.01 and 1.15%).

Similarly fishes fed with T_5 diet exhibited highest specific growth rate (length) during different days of the experiment and the values recorded were 0.41, 1.01, 1.63 and 1.85%. After the experiment lowest specific growth rate (weight and length) of 1.01 and 1.15% were noticed in the control fishes. Fishes grown in the veterinary growth promoters supplemented diets differ significantly ($P< 0.05$) in their specific growth rate values.

4.4.3 Biochemical composition

Water content

Water content in the muscle tissues of *C.catla* at the beginning and end of the experiment in the control and six different treatments are given in Figure19. Water content observed before experiment in the muscle tissues was 72.30%. After 60 days of the experimental period, 10% Supplevite® supplemented diet fed fishes (T_5) showed highest water content (76.37%), followed by T_2 (76.06%), T_6 (75.45%), T_3 (74.94%), T_4 (73.67%) and T_1 (73.56%). The lowest water content (73.19%) was estimated in the control fishes.

Protein

Muscle protein content of the control and experimental fishes before and after experiment are shown in Figure 20. Protein content recorded at the beginning of the experiment in the muscle tissue of *C.catla* was 17.15%. After the experimental period maximum protein content (18.93%) was noticed in *C.catla* grown in T_5 feed, followed by T_2 (18.85%), T_6 (18.64%), T_3 (18.55%), T_4 (18.24%) and T_1 (18.14%). Fishes grown in control showed minimum protein content (18.01%) than the other treatments. All the different concentrations of veterinary growth promoters supplementation improved the muscle protein content in the experimental fishes. However, 10% Supplevite® incorporated diet fed fishes showed maximum protein content.

Carbohydrate

Carbohydrate content noticed in the muscle tissue of *C.catla* in the control and six different treatments are presented in Figure 21. 4.28% of carbohydrate content was recorded in *C.catla* at the beginning of the experiment. At the end of the experiment, carbohydrate content was maximum (5.42%) in T_5 fishes fed with 10% supplevite® incorporated diet, followed by T_6 (5.33%), T_2 (5.33%), T_3 (5.23%), T_4 (4.63%), and T_1 (4.62%). The minimum carbohydrate content (4.56%) was obtained in the control fishes.

Fat

Fat content obtained in the control and experimental fishes before and after experiment is shown in Figure 22. Before experiment fat content recorded in the muscle tissues of *C.catla* was 2.36%. *C.catla* fed with T_5 feed exhibited highest fat

content (3.05%), followed by T_6 (3.01%), T_2 (3.00%), T_3 (2.96%), T_4 (2.71%) and T_1 (2.67%). The lowest fat content (2.55%) was recorded in the control fishes.

Ash

Figure 23 revealed ash content in the muscle tissues of *C.catla* in the control and six different treatments. At the beginning of the experiment, ash content recorded in the muscle tissues of *C.catla* was 1.90 %. After 60 days feeding of veterinary growth promoters supplemented diet, fishes fed with 10% Supplevite® supplemented feed showed maximum ash content (2.83%) and minimum ash content (2.31%) was recorded in *C.catla* grown in control.

Calorific content

Before experiment, calorific content estimated in the muscle tissues of *C.catla* was 135.27 Kcal/gm (Figure 24). Highest calorific content (157.98 Kcal/gm) was recorded in T_5 fishes after 60 days of the experimental period and lowest calorific content (144.01 Kcal/gm) was estimated in *C.catla* grown in control diet.

Veterinary growth promoters Vimeral® and Supplevite® incorporation enriched the muscle proximate composition in the experimental fishes. All these biochemical parameters when analysed statistically, the results were found to be significant at $P< 0.05$.

4.4.4 Feed utilization efficiencies

Feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV) and feed efficiency (FE) were analysed in *C.catla* fed with control and six different experimental

feeds after 60 days of experimental period and are summarized in the Table 24.

Feed conversion ratio

Feed conversion ratio showed significant variation ranging from 1.71 to 2.51%. Maximum feed conversion ratio (2.51%) was noticed in the control fishes, followed by T_1 (2.35 %), T_4 (2.21 %), T_3 (1.75 %), T_2 (1.72 %) and T_6 (1.71 %). Minimum feed conversion ratio of 1.70% was recorded in fishes grown in T_5 feed. The difference in feed conversion ratio found among fishes of different treatments was found to be statistically significant ($P<0.05$).

Protein efficiency ratio

Protein efficiency ratio was significantly varied from 1.58 to 2.34 % in the control and experimental fishes. The highest protein efficiency ratio (2.34%) was obtained in *C.catla* grown in T_5 diet and lowest protein efficiency ratio (1.58%) was noticed in control fishes. Fishes fed with different experimental diets vary significantly in their protein efficiency ratio.

Protein productive value

Among the six different treatments and control, protein productive values were ranged from 3.00 to 5.72%. The highest protein productive value (5.72%) was observed in T_5 fishes, followed by T_2 (5.67 %), T_6 (4.60%), T_3 (4.60 %), T_4 (3.80 %) and T_1 (3.78 %). The lowest protein productive value (3.004%) was recorded in the control fishes. Protein productive values observed in the six different treatments were found to be statistically significant ($P<0.05$) when compared with control.

Feed efficiency

Feed efficiency was ranged from 25.01 to 46.13% in the control and experimental fishes. Fishes fed with T_5 feed showed highest feed efficiency (46.13%), followed by T_6 (43.80%), T_2 (43.38%), T_3 (41.42%), T_4 (38.17%) and T_1 (36.02%). The lowest feed efficiency (25.01%) was recorded in the control fishes. *C.catla* fed with veterinary growth promoters incorporated feeds exhibited significant ($P<0.05$) feed efficiency values.

TABLE - 19

Protein, carbohydrate and fat contents (%) in the control and veterinary growth promoters supplemented feeds.

Feed	Treatments	Concentrations (%)	Protein	Carbohydrate	Fat
Control	C	---	34.12	12.82	14.01
Vimeral®	T_1	5	35.21	12.98	14.23
	T_2	10	35.34	13.13	14.38
	T_3	15	35.48	13.15	14.46
Supplevite®	T_4	5	35.21	13.01	14.35
	T_5	10	35.42	13.06	14.48
	T_6	15	35.58	13.18	14.50
SED			0.0130	0.0048	0.0050
CD (0.05)			0.0270	0.0100	0.0107

Values are the mean of three replicates

TABLE - 20

Weight gain (%) in *Catla catla* during different days of the experiment in the control and veterinary growth promoters supplemented feeds.

Feed	Treat ments	Concen trations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	10.01	20.23	32.48	41.00
Vimeral®	T_1	5	14.01	22.42	43.16	57.63
	T_2	10	16.28	30.83	51.57	69.41
	T_3	15	15.48	27.12	48.10	66.28
Supplevite®	T_4	5	15.98	26.75	50.53	61.07
	T_5	10	19.38	34.84	59.03	73.82
	T_6	15	17.27	32.86	56.32	70.07
SED			0.0059	0.0101	0.0174	0.0222
CD (0.05)			0.0128	0.0216	0.0368	0.0484

Values are the mean of three replicates

TABLE - 21

Length gain (%) in *Catla catla* during different days of the experiment in the control and veterinary growth promoters supplemented feeds.

Feed	Treatments	Concentrations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	8.12	12.13	17.46	24.33
Vimeral®	T_1	5	9.21	18.43	25.76	36.33
	T_2	10	10.12	23.40	53.19	72.34
	T_3	15	9.88	21.35	50.24	70.90
Supplevite®	T_4	5	9.65	19.11	29.92	38.72
	T_5	10	10.94	27.66	59.57	80.85
	T_6	15	10.21	25.33	57.33	77.10
SED			0.0038	0.0085	0.0166	0.0236
CD (0.05)			0.0082	0.0180	0.0324	0.0502

Values are the mean of three replicates

TABLE - 22

Specific growth rate in percentage (weight) in *Catla catla* during different days of the experiment in the control and veterinary growth promoters supplemented feeds.

Feed	Treat ments	Concen trations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.22	0.69	1.01	1.15
Vimeral®	T_1	5	0.38	0.72	1.20	1.41
	T_2	10	0.48	0.96	1.30	1.55
	T_3	15	0.43	0.86	1.28	1.51
Supplevite®	T_4	5	0.46	0.85	1.31	1.45
	T_5	10	0.62	1.04	1.42	1.59
	T_6	15	0.54	1.00	1.39	1.55
SED			0.0002	0.0003	0.0004	0.0007
CD (0.05)			0.0003	0.0006	0.0008	0.0014

Values are the mean of three replicates

TABLE - 23

Specific growth rate in percentage (length) in *Catla catla* during different days of the experiment in the control and veterinary growth promoters supplemented feeds.

Feed	Treat ments	Concen trations (%)	No. of days during experiment			
			15	30	45	60
Control	C	---	0.25	0.55	0.72	1.01
Vimeral®	T_1	5	0.28	0.78	1.03	1.27
	T_2	10	0.35	0.96	1.55	1.77
	T_3	15	0.33	0.89	1.51	1.76
Supplevite®	T_4	5	0.31	0.81	1.13	1.32
	T_5	10	0.41	1.08	1.63	1.85
	T_6	15	0.36	1.01	1.60	1.82
SED			0.0001	0.0003	0.0005	0.0006
CD (0.05)			0.0002	0.0007	0.0010	0.0015

Values are the mean of three replicates

TABLE - 24

Feed utilization efficiencies (%) of *Catla catla* in the control and veterinary growth promoters supplemented feeds.

Feed	Treatments	Concentrations (%)	FCR	PER	PPV	FE
Control	C	---	2.51	1.58	3.00	25.01
Vimeral®	T_1	5	2.35	1.94	3.78	36.02
	T_2	10	1.72	2.23	5.67	43.38
	T_3	15	1.75	2.11	4.60	41.42
Supplevite®	T_4	5	2.21	2.08	3.80	38.17
	T_5	10	1.71	2.34	5.72	46.13
	T_6	15	1.71	2.13	4.60	43.80
SED			0.0007	0.0008	0.0014	0.0146
CD (0.05)			0.0015	0.0017	0.0011	0.0282

Values are the mean of three replicates

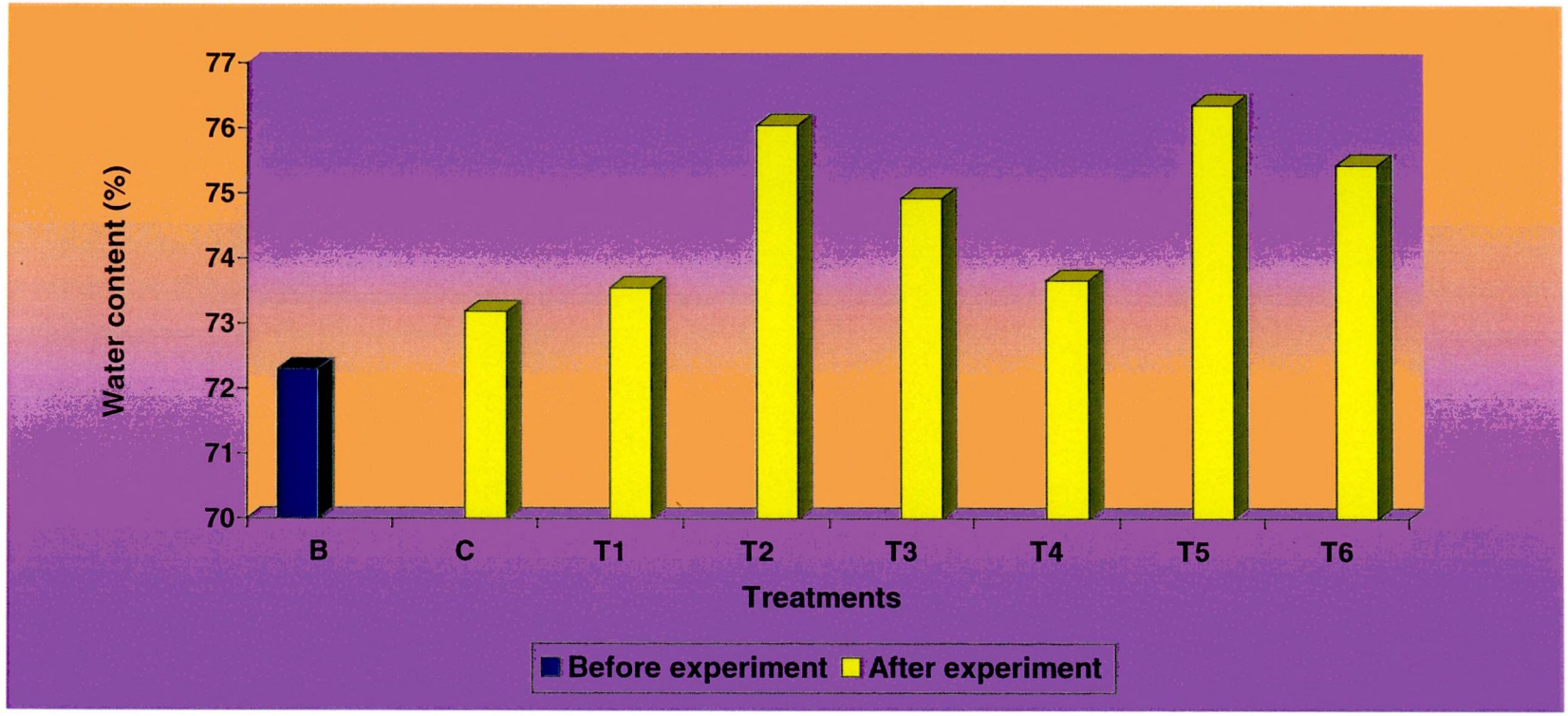

Figure - 19

Water content (%) in the muscle tissues of *Catla catla* in the control and veterinary growth promoters supplemented feeds before and after experiment.

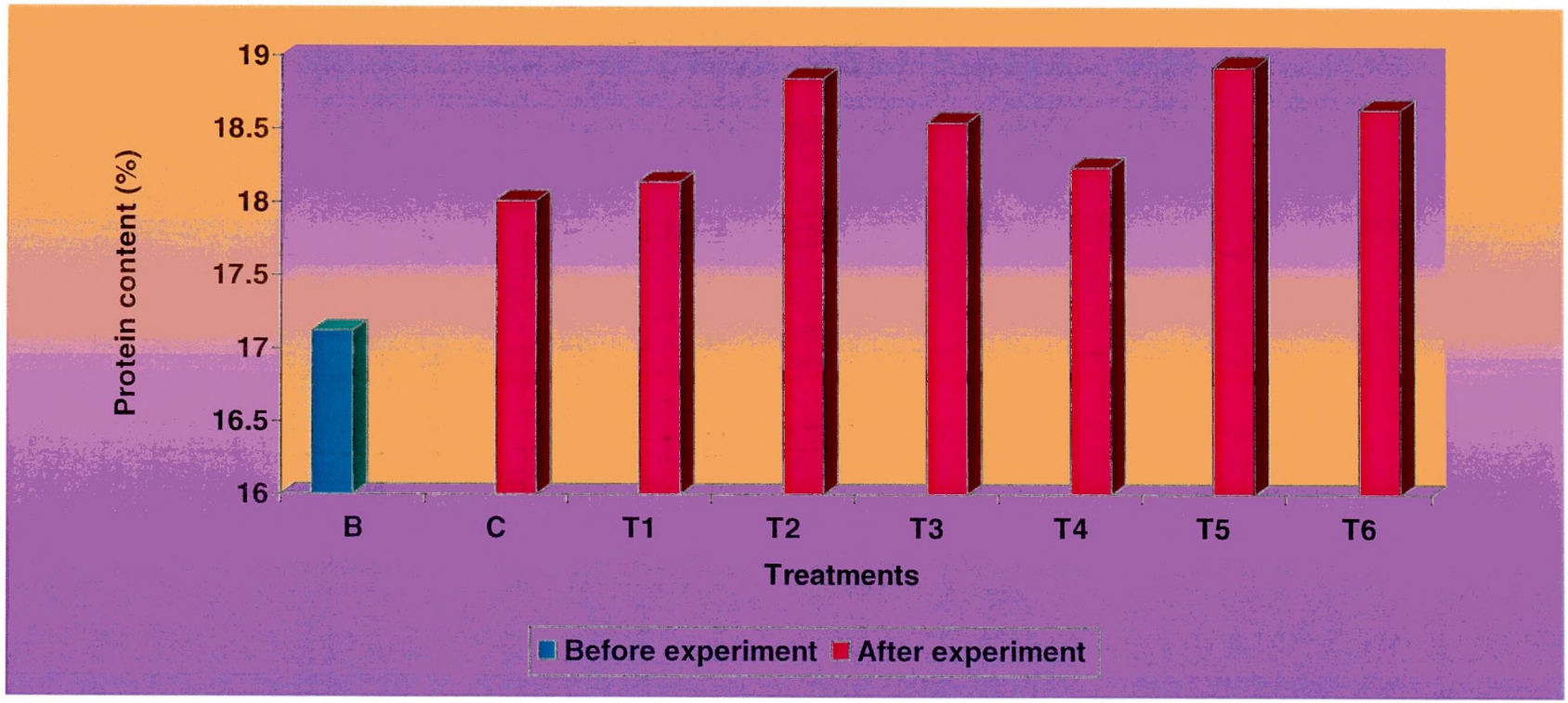

Figure - 20

Protein content (%) in the muscle tissues of *Catla catla* in the control and veterinary growth promoters supplemented feeds before and after experiment.

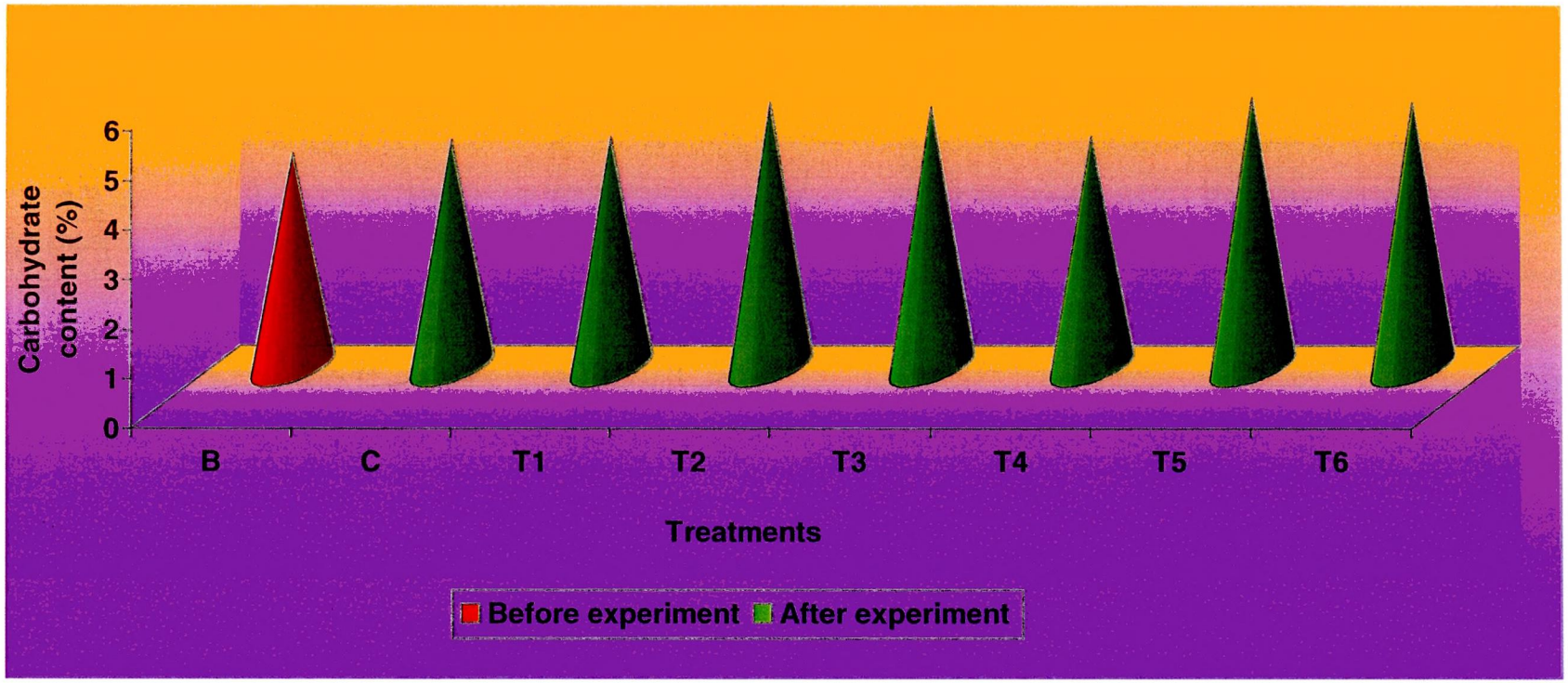

Figure - 21

Carbohydrate content (%) in the muscle tissues of *Catla catla* in the control and veterinary growth promoters supplemented feeds before and after experiment.

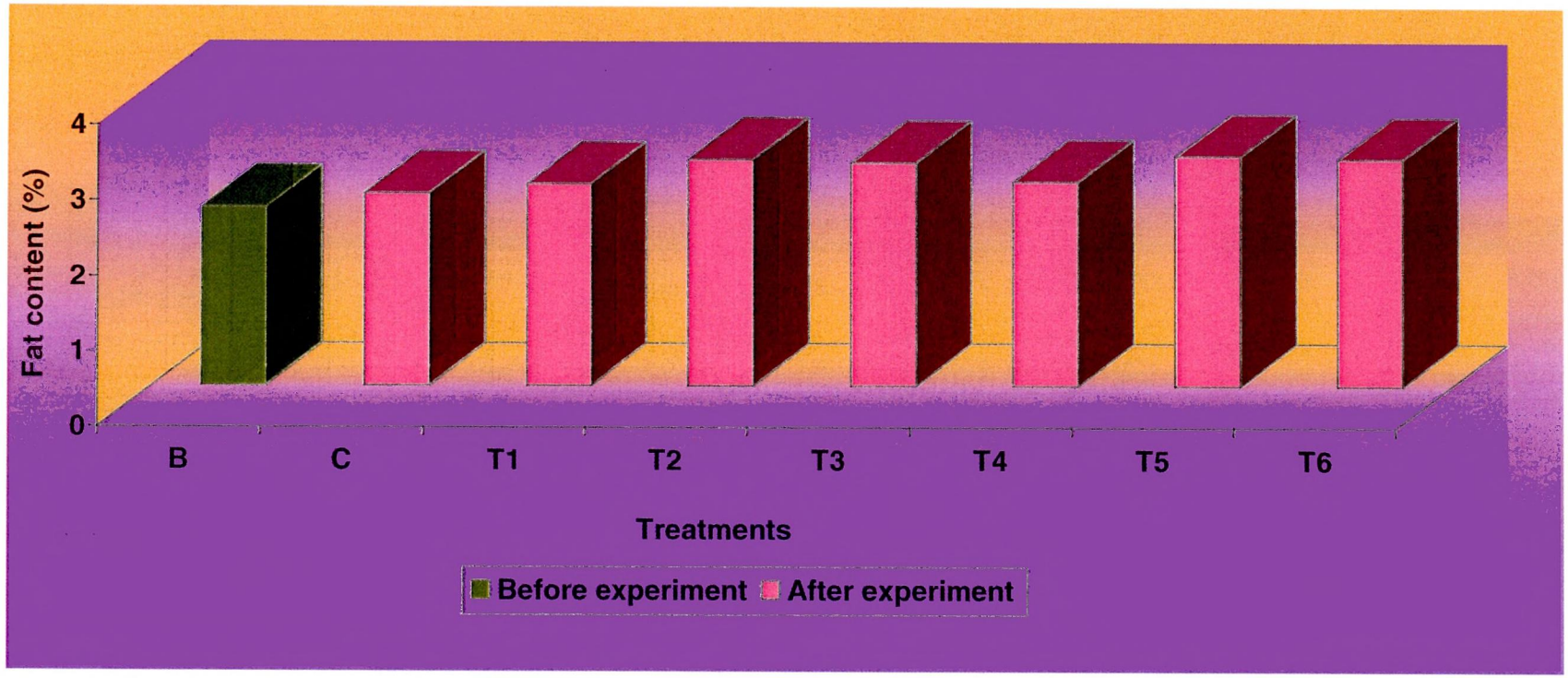

Figure - 22

Fat content (%) in the muscle tissues of *Catla catla* in the control and veterinary growth promoters supplemented feeds before and after experiment.

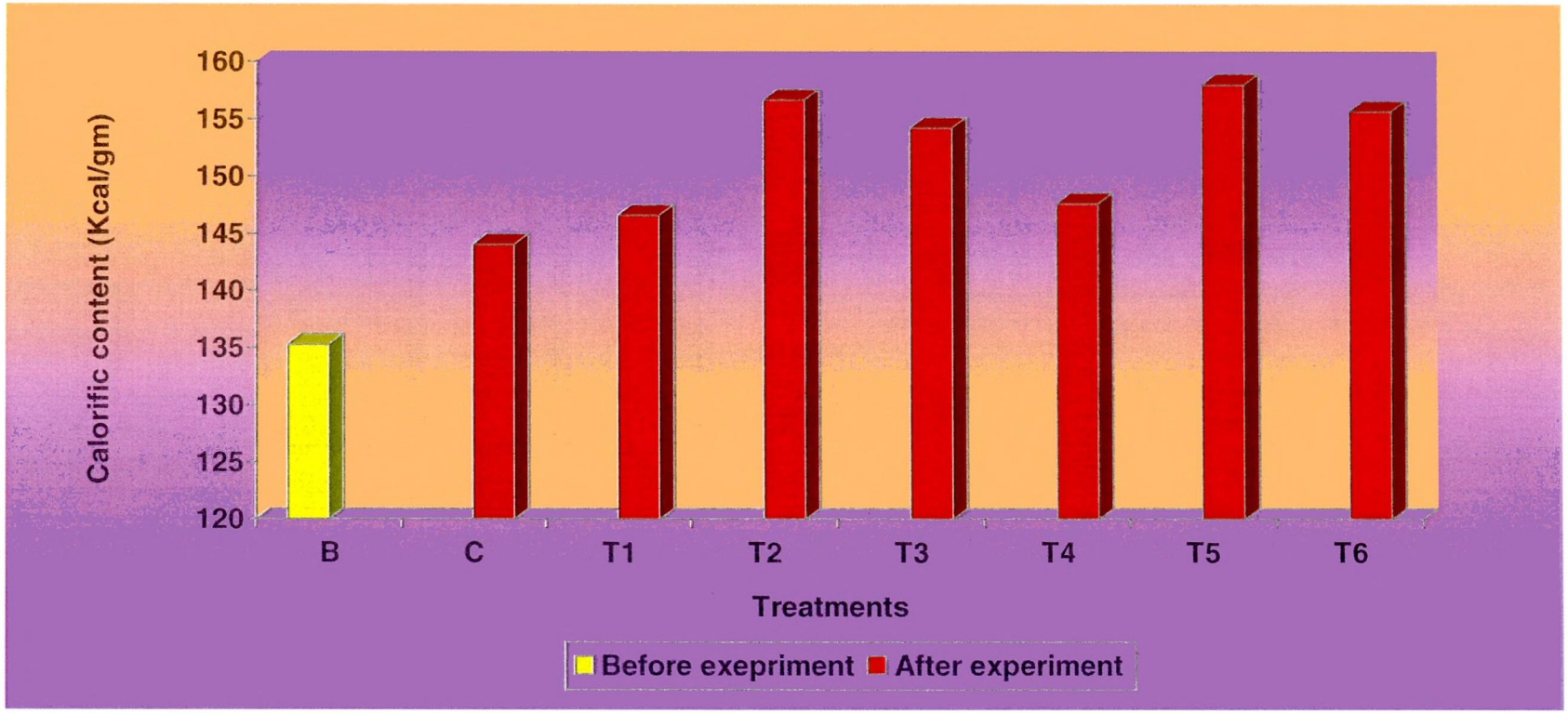

Figure - 24

Calorific content (kcal/gm) in the muscle tissues of *Catla catla* in the control and veterinary growth promoters supplemented feeds before and after experiment.

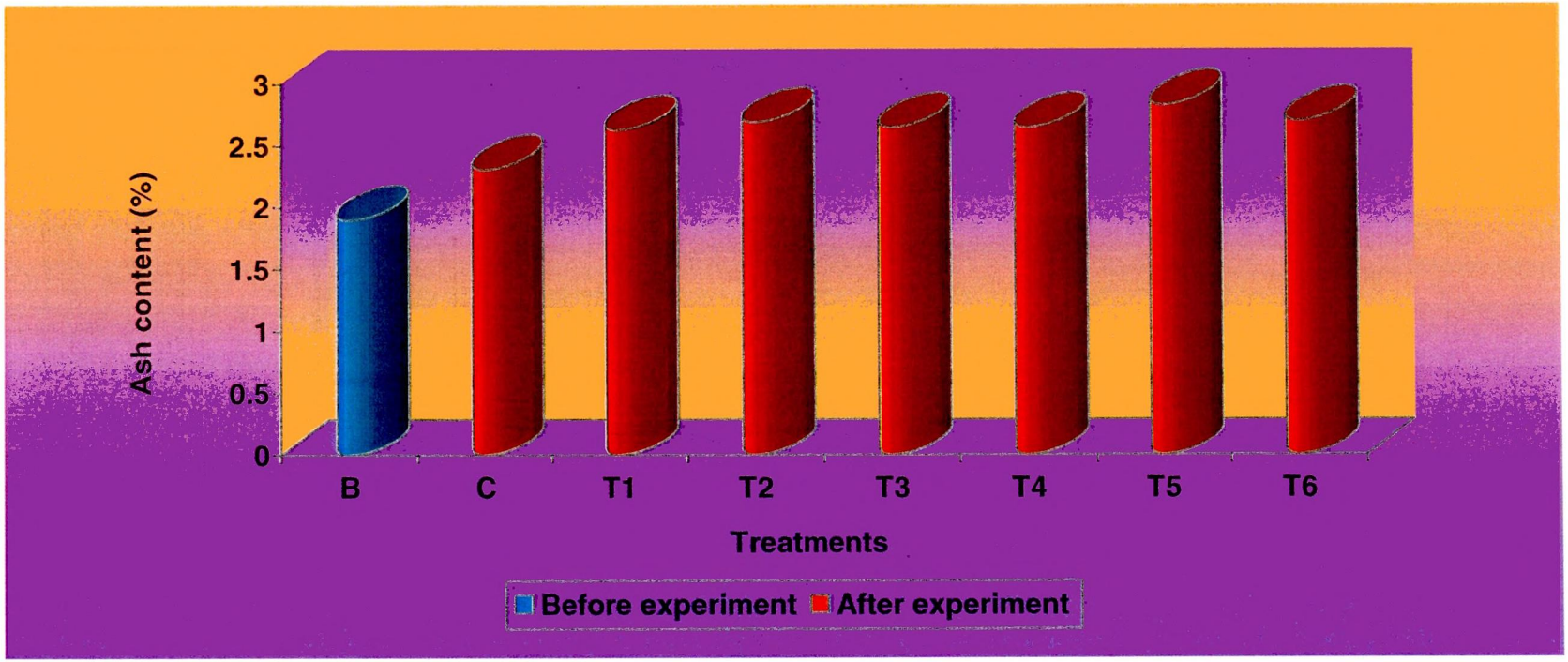

Figure - 23

Ash content (%) in the muscle tissues of *Catla catla* in the control and veterinary growth promoters supplemented feeds before and after experiment.