

Physiological Response of Non-descript Bullocks of Chhattisgarh in Rotary Unit during Electricity Generation

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ABSTRACT:

This paper is focused to study the physiological response of non-descript bullocks of Chhattisgarh during electricity generation by the use of rotary unit. To increase the annual utilization with good efficiency of draught animal by using suitable devices for electricity generation and battery charging, chaff cutting, winnowing and threshing need to be developed and tested accordingly physiological response of bullocks. Stationary type of work (i.e. chaff cutting, winnowing and threshing) can be performed by the animal power, using a suitable rotary gear system. Therefore a study, with a rotary unit and physiological response of a pair of non-descript breed of bullocks was carried out for electricity generation. Physiological responses of bullocks in terms of pulse rate, respiration rate and body temperature were recorded during the work increasing with advancing of working time. During seven hours of work the animal body temperature, respiration rate and pulse rate were increased by 44 °C, 51 blows/min and 68 bpm at load condition. It has been found that efficiency of bullocks are decreasing with the passing of time as the bullocks were not fatigue after 7 hours of work as they scored 19 points against the fatigue level score of 20 points. The power output developed by bullocks during electricity generation and battery charging was found to be 0.264 KW.

KEY WORDS: Bullocks, Rotary power, Physiological response, Draft, work load.

INTRODUCTION:

India has a large population of draught animals and bullocks which are main draft animals in the country followed by he-buffaloes. Generally draft animals are used for tillage, seeding, intercultural and transportation. With increased availability of other source of power like electricity, I.C. engine etc. utilized of draught animal as per considerably demand. The animals give stability to agriculture by subsidizing the income of the farmers. Draught animals are known to be widely used for selected crop production operation during cropping season and left idle for the rest of period. This is possible through employing animal in the rotary mode of power to operate different agro processing machines (Srivastava, 2000). Physiological response of Malvi breed of bullocks in rotary power transmission system for electricity generation (Singh and Singh, 2013) found that efficiency of rotary power transmission system is 58% and the bullocks were not fatigue after 6 hours of work as they scored 16 points against the fatigue level score of 20 points. In Chhattisgarh the majority of the animals are non-descript breed of bullocks and these are used in agricultural operations. Scientific and technical information on what extent the bullocks of Chhattisgarh breed can be loaded without inflicting any health hazard and their draughtability under different loads and climatic

conditions are not available. The working performance of draught animals depends on breed, sex, age, weight, size, health, quality of feed, training for the work, type of harness, duration of work and environmental conditions. Several attempts have been made by the researchers to find out the draughtability of bullocks, but the farmers are still dependent on their experience, which inhibits the use of advanced animal drawn machinery (Dave and Mukherjee, 2001). In Chhattisgarh the animals are used for 40-50 days in a year for agricultural operations and the rest of the period is idle for the animals. This idle period can be utilized to operate some processing machinery through 'Rotary Mode of Operation'. In view of the aforesaid facts, development of an animal power complex to utilize the idle period of farm animals may be an appropriate alternative. Thus this study was based on to study the physiological response of non-descript bullocks of Chhattisgarh in rotary unit during electricity generation and battery charging as to overcome the utilization of animal power for electricity generation in remote areas through rotary mode of operation will make the farmers self-sufficient (Anon. 2008).

MATERIALS AND METHOD:

An existing setup installed by the AICRP on UAE, department of farm machinery and power, has been used in this experiment at Faculty of Agricultural Engineering and Technology IGKV Raipur.

ANIMAL POWERED ROTARY UNIT:

The rotary unit was developed to convert the animal power into mechanical power for operating the different agricultural processing machines. To make the complete unit economically viable, one pair of bullocks was used to generate power. For safer design of animal powered rotary unit, the ultimate power developed by a pair of bullocks can be assumed as 0.75 kW. This power will be used for electricity generation and battery charging. In general, the basic parts, which have been used for animal power into mechanical power is rotary unit. There were rectangular gearbox, beam, shafts and pulleys etc. The power transmission unit consists of a rectangular gearbox of size 740x480x30 mm made of 10 mm thick M. S. Plate and 50x50x5 mm M.S. angle iron frame. Four shafts 3 vertical and one horizontal namely input shaft, 2 intermediate shafts and final drive shaft with spur and bevel gears are provided to transmit power from input shaft to final drive shaft. The top cover of the box is removable to facilitate fitting of different components. The input shaft of the gearbox is 50 mm in diameter. It is provided with 77 teeth gear of 4mm module. It is supported on two ball bearings, a 50 mm bearing at the top and a 45 mm bearing at the lower end. The top of this shaft is machined to a square shape to mount the beam to be hitched with a pair of animal. The intermediate shaft is also of 50 mm diameter made of M. S. rod. Two gears are mounted on this shaft one of 77 teeth and another of 18 teeth. The shaft is supported at both the ends on 40 mm ball bearings. The third shaft is of 40 mm diameter and has 18 teeth 4 mm module spur gear and a 24 teeth bevel gear. It is supported at both the ends on 30 mm diameter ball bearings. The horizontal drive (output) shaft is of 50 mm diameter and has a 13 teeth bevel gear at one end and a flange at the other end. The shaft is mounted on two 30 mm diameter ball bearings. This shaft extends beyond the gearbox and the flange is provided outside the box.

EXPERIMENTAL BULLOCKS:

The rotary unit was powered by using a pair of non-descript breed bullocks between age group of 6 to 7 years.

SPECIFICATION OF THE BULLOCKS :

S.N.	Particulars	Non-descript breed of bullock
1	Average girth, mm	2250
2	Average body length(from tuber center to point of soldier), mm	850
3	Length of the soldier in the contact with the yoke, mm	220
4	Length of fore leg, mm	1450
5	Length of hind leg, mm	1250
6	Average circumference of hoof on fore leg, mm	380
7	Average circumference of hoof on hind leg, mm	320
8	Width of neck, mm	600

Yoke:

An improved yoke was used in the present investigation. The modified yoke was found suitable for the non-descript breed of bullocks commonly used in this region to pull the loads up to 12 % of their body weight for continuous four hours in rainy and winter seasons This yoke had a raised portion on both sides for higher contact area with bullock's hump and one projection at the center for better hitching purpose.

Specifications of the yoke

S.N.	Particulars	Specifications
1	Fabrication material	Ber wood
2	Total length, mm	1370
3	Section dimension, mm	80 x 70
4	Weight, kg	4.3

PHYSIOLOGICAL RESPONSE:

The physiological parameters of working bullocks such as heart rate, respiration rate, rectal temperature and fatigue symptoms were recorded at the start of work and after every hour of work. A work rest cycle of 4 h Work – 2h rest – 3h Work was followed to measure the physiological responses of bullocks. The respiration rate was measured by counting the number of hot gushes of exhaled air per minute blowing against the back of the palm kept near the nostrils of the animal. Respiration rate is the gaseous exchange between an organism and atmosphere. It is directly affected by draught exerted and the duration of working hours. The trend or effect of draught respiration is recorded every one hour. The pulse rate of bullock was measured by placing the finger on the coccygeal artery under the tail of the bullock and it is counting the number of beats per minute. It increases with increase in draught and number of working hours. It was observed every one hour. Pulse rate is measured by stethoscope. The body temperature of the bullocks was measured by inserting the digital thermometer probe in the rectum of bullock for about two minutes. Body temperatures during battery charging were recorded at every one hour.

(a)

(b)

(c)

Fig. Measurement of (a) pulse rate, (b) respiration rate and (c) body temperature

RESULT AND DISCUSSIONS:**PHYSIOLOGICAL RESPONSE OF BULLOCKS DURING BATTERY CHARGING:**

In general, the pulse rate, respiration rate and body temperature of bullocks increased with duration of operation. The speed of operation was also found to be decreased with duration of work. In the initial session of work, these parameters increased at higher rate in starting hours. In the last session of work after rest, the increase in pulse rate, respiration rate and body temperature was lower than that of first session. During the rest, the pulse rate, respiration rate and body temperature were observed to decrease gradually. Similar result was found by Anon. 2008.

VARIATION IN PULSE RATE:

The average variation in pulse rate of bullocks with respect to time of working is given in Table 1 and Fig. 1. The data revealed that pulses rate of bullocks was increased with the duration of work. The average initial pulse rate (beats/min.) of bullocks was 42 at starting time and increased to 47, 56, 64, 68 after 1st, 2nd, 3rd, 4th hour of operation respectively during first session of the operation. After given 2 hours of rest to the bullocks initial reading was observed as 44 which was increased to 50, 58 and 60 after, 5th, 6th and 7th hour of operation respectively. The highest pulse rate was recorded as 68 beats/min. The average pulse rate of bullocks was 55 beats/min.

VARIATION IN RESPIRATION RATE:

Table 1 and Fig. 2 shows, the average variation in respiration rate of bullocks with respect to time of working. The data found by the experiment which shows that the respiration rate of bullocks was increased with the duration of work. The average initial respiration rate (blows/min.) of bullocks was 24 at rest and increased to 32, 41, 48, 51 after 1st, 2nd, 3rd, 4th hour of operation respectively during first session of the operation. After given 2 hours of rest to the bullocks initial reading was observed as 27 which was increased 34, 45 and 50 after 5th, 6th and 7th hour of operation. The highest respiration rate was recorded as 51 blows/min. The average respiration rate of bullocks was 39.1 blows/min.

VARIATION IN BODY TEMPERATURE:

From experiment it is clear that the body temperature of bullocks was increased with duration of work which is shown in Table1 and Fig. 3. The average initial body temperature ($^{\circ}$ C) of bullocks was 37.06 at rest and increased to 37.28, 37.6738 and 38.44 after 1st, 2nd, 3rd, 4th hour of operation respectively during first session of the operation. After given 2 hours of rest to the bullocks initial reading was observed as, 37.16, which was

increased 37.39, 37.85 and 42 after 5th, 6th and 7th hour of operation. The highest body temperature was recorded as 42 °C. The average body temperature of bullocks was 38.66 °C.

VARIATION IN SPEED:

The average variation in speed of bullocks with respect to time of working is given in Table 1 and Fig. 4. The data revealed that speed of bullocks was decreases with the duration of work. The average initial speed (kmph) of bullocks during first hour of operation was 3.37 and decreased to 3.25, 3.16, 3.04 during 1st, 2nd, 3rd, 4th hour of operation respectively during first session of the operation. After given 2 hours of rest to the bullocks initial reading was observed as 2.94 which was increased 3.35, 3.28 and 3.20 after 5th, 6th and 7th hour of operation. The highest speed was recorded as 3.37 kmph. The average speed of bullocks was 3.23 kmph.

VARIATION IN FATIGUE:

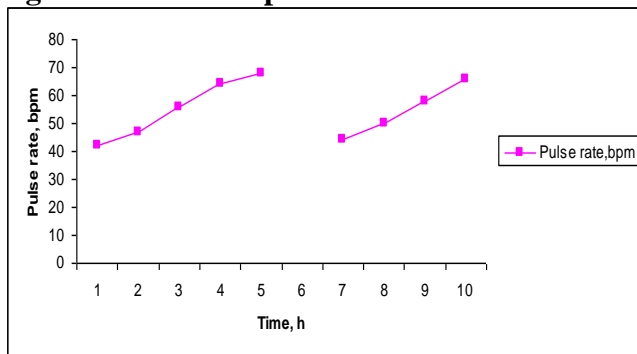
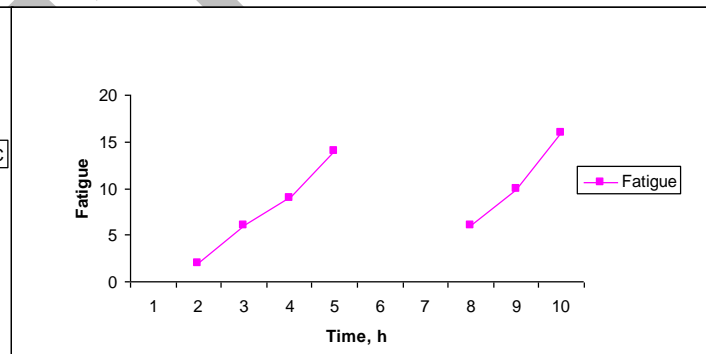
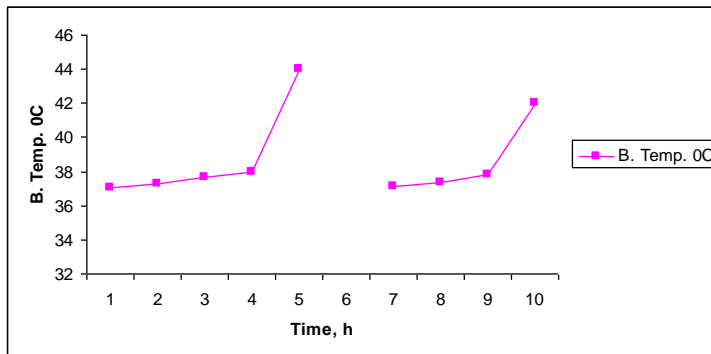
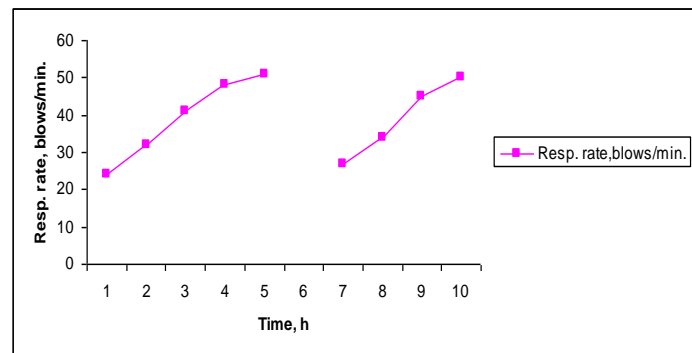
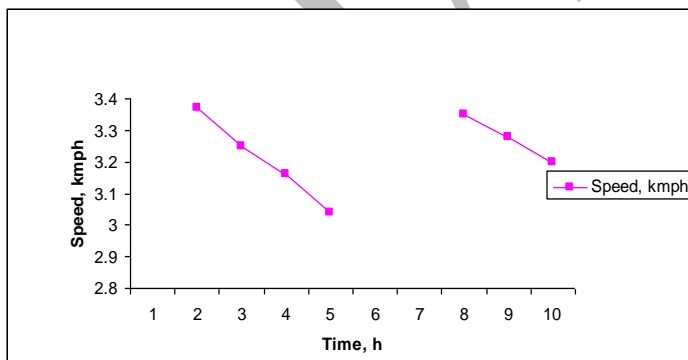
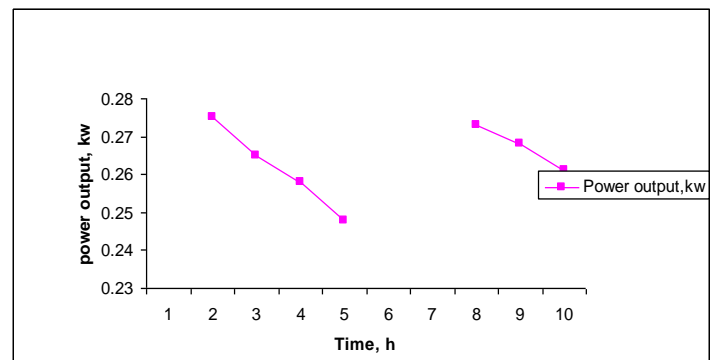
The average variation in fatigue of bullocks with respect to time of working is given in Table 1 and Fig. 5. The data revealed that fatigue of bullocks was increases with duration of work. The average initial fatigue of bullocks was 0 at rest and increased to 2, 6, 9, 14, after 1st, 2nd, 3rd, 4th hour of operation respectively during first session of the operation. After given 2 hours of rest to the bullocks initial reading was observed as 6 which was increased 10, 16 and 19 after 5th, 6th and 7th hour of operation. The highest fatigue was recorded as 19. The average fatigue of bullocks was 10.86.

VARIATION IN POWER OUTPUT:

The average variation in power output of bullocks with respect to time of working is given in Table 1 and Fig.6. The data revealed that power output of bullocks was decreases with duration of work. The average initial power output KW of bullocks was 0 at rest and increased to 0.275, 0.265, 0.258, 0.248, 0.273 after 1st, 2nd, 3rd, 4th hour of operation respectively during first session of the operation. After given 2 hours of rest to the bullocks power output 0.273, 0.268 and 0.261 after 5th, 6th and 7th hour of operation respectively. The highest power output was recorded as 0.275 KW. The average power output of bullocks was 0.264 KW.

TABLE 1. PHYSIOLOGICAL PARAMETERS OF BULLOCKS:

Hours P.P	Initial	1	2	3	4	2 hour rest	initial	7	8	9	Average
Pulse rate, bpm	42.00	47.00	56.00	64.00	68.00	-	44.00	50.00	58.00	66.00	55.00
Resp. rate, bpm	24.00	32.00	41.00	48.00	51.00	-	27.00	34.00	45.00	50.00	39.10
B. Temp., °C	37.06	37.28	37.67	38.00	44.00	-	37.16	37.39	37.85	42.00	38.66
Fatigue	-	2.00	6.00	9.00	14.00	-	6.00	10.00	16.00	19.00	10.86
Speed, kmph	-	3.37	3.25	3.16	3.04	-	-	3.35	3.28	3.20	3.23
Power output, kw	-	0.27	0.26	0.25	0.24	-	-	0.27	0.26	0.26	0.26

Fig. 1. Variation in pulse rate**Fig. 2. Variation in respiration rate****Fig. 3. Variation in body temperature****Fig. 4. Variation in fatigue****Fig. 5. Variation in speed****Fig. 6. Variation in power output****CONCLUSION:**

The power output developed by bullocks reduced with passage of time. The highest value of power output developed by bullocks calculated as 0.275 KW, respectively after the seven hours of work. The minimum power output of the bullocks was calculated as 0.248 KW, respectively after the seven hours of work. The average speed of travel of bullocks during work was found to be 3.34 kmph whereas the average power output was 0.264 KW. The maximum pulse rate of bullocks was recorded as 68 beat per minute after seven hours of work. The highest value of body temperature of bullocks was recorded as 44 °C. Fatigue score of bullocks is an important indicator the performance of animal. The highest fatigue score of bullocks during the experiment was analyzed as 19 and lowest fatigue score was 2.

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REFERENCES:

1. Anon., 2008. AICRP on Utilization of Animal Energy with Enhanced System Efficiency. IGKV, Raipur Centre Bulletin No. IGKV/Pub/2008/53.
2. Dave, A.K. and Mukherjee, A.P., 2001. Study on Draught Capacity of Bullocks in Bastar Region, India. Draught Animal News, No. 34.
3. Rawat, S.N., 2004. Performance Evaluation of Different Yokes and their Comparison in Relation to Non-Descript Breed of Bullocks of Chhattisgarh. M.Tech. Thesis, Indira Gandhi Agricultural University, Raipur (C.G.).
4. Singh, C.D. and Singh, R.C., 2013. Study on Physiological Response of Malvi Breed Bullocks in Rotary Mode Power Transmission System for Electricity Generation. Journal of Agricultural Engineering Today.
5. Srivastava, N.S.L., 2000. Animal Energy in Agriculture. Journal of Agricultural Engineering Today, 24: 24-26.
6. Updhay, R.C. and Madan, M.L., 1985. Draught Performance of Haryana and Cross Breed Bullocks. Indian Journal of Animal Science, 50:55.
7. Vaugh, M., 1947. Report on Detailed Study of Methods of Yoking Bullocks. Indian Journal of Veterinary Science and Animal Husbandry. 15(1): 30-35.
8. Yadav, S.B., Jogdand, S.V., Victor, V.M. and Katre, Prafull, 2004. All India Coordinated Research Project on Increased Utilization of Animal Energy with Enhanced System Efficiency. Biennial Report 2004. IGKVV, Raipur.