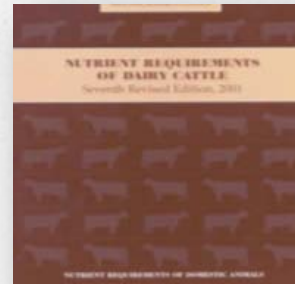


# SIGNIFICANCE OF BULL NUTRITION FOR SUCCESSFUL BREEDING





## INTRODUCTION



- Nutrient intakes below requirements result in reduced growth rates and delayed puberty in the male and if severe enough, can permanently impair sperm output.
  - Reason: reduces testicular weight, secretory output of the accessory sex glands, sperm motility and sperm concentration
  
- Reproductive potential of young males also impaired by overfeeding.
  - Reason: fat deposition around scrotum decreases thermoregulation which subsequently decreases sperm synthesis, epididymal sperm reserves, and seminal quality
  - Overly body fat also increases stress on the bull and limits his ability to travel to search out and service cows that are in estrus.

## DIFFERENT STAGES OF A BULL'S LIFE

- 1. Pre-weaning



- 2. Post-weaning to 30-60 days pre-breeding



- 3. Conditioning prior to breeding



- 4. Management during breeding





## PRE-WEANING



- o Balanced nutrition at advance pregnancy stage of dams is important for getting healthy calves otherwise: - Lower birth weights, - Lower weaning weights and -higher death rates of calves
- o Nutritionally dam should be made available all essential nutrients to nurse the calf well
- o At the early Stage of life bull calves should be fed mainly on dam's milk and should be supplemented with good quality forage and calf starter to get start the rumen functioning at the earliest.

## SPECIFICATION FOR CALF STARTER

Characteristics	Calf Starter Meal
CP (%), min.	23
Crude fat (%), min.	4
Crude fiber (%), Max.	7
Acid insoluble ash (%), max.	2.5
Iodised common salt (%), max.	1
Ca (%), min.	0.5
P (%), min.	0.5
Available Phosphorus (%), min.	0.2
Urea (%), max.	Nil
Calcite powder (%) max.	1
Vit-A (IU/kg), min.	10,000
Vit-D3 (IU/kg), min.	2,000
Vit-E(IU/kg), min.	150
Aflatoxin B1 (ppb), max.	20



## CALF-STARTER



NDDDB has developed calf starter in 3 mm pellets, which contains:

- o Calcium propionate
- o Vitamins A, D<sub>3</sub>, E
- o Mineral mixture
- o This calf starter helps in faster growth & early maturity of young calves.
- o Calf starter should be fed second week onwards



## Calf starter for faster growth & early maturity

- Optimum level of nutrition in early life favors faster growth, earlier onset of puberty.
- Calves need to be reared to obtain optimum gain in body weight, so that they attain about 75-80 per cent of mature body weight at puberty.
- Poor feeding of young calves leads to higher age at puberty and overall loss of productive life.

## **CALF STARTER**



**FEEDING CALF STARTER TO  
YOUNG CALVES HELP IN FASTER  
GROWTH & EARLY MATURITY**





**Calf starter for early development of rumen**



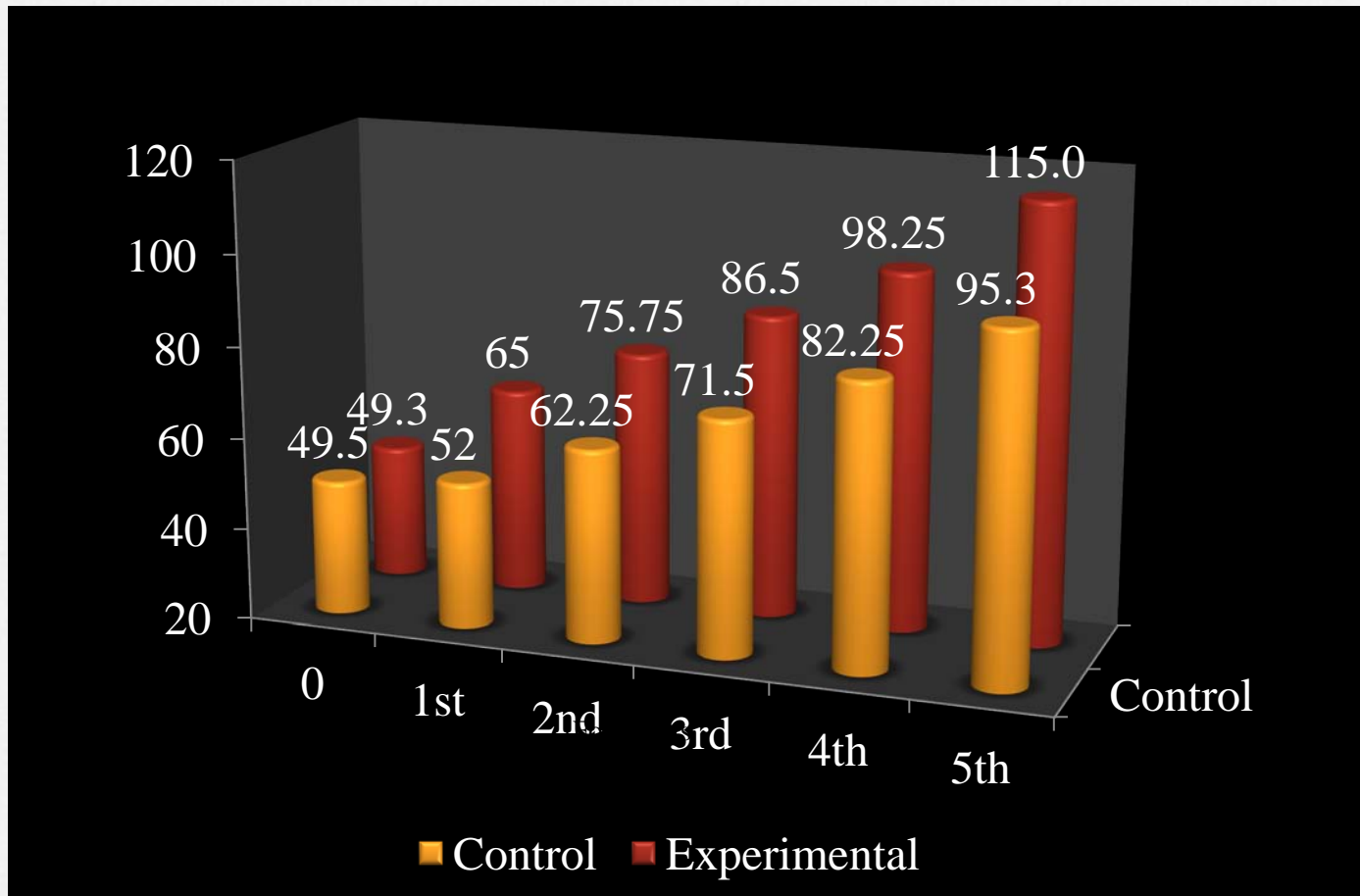
**Underdeveloped rumen**



**Volatile Fatty Acids**  
**80% source of energy**

**Developed rumen**

## EFFECT OF FEEDING CALF STARTER ON BODY WEIGHT GAIN IN CALVES





Control

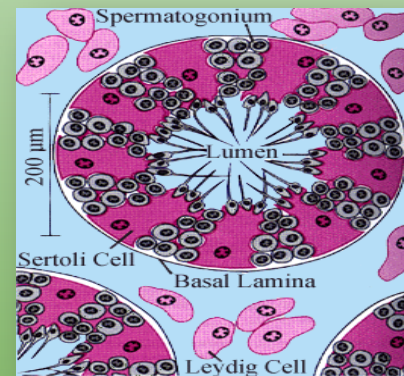
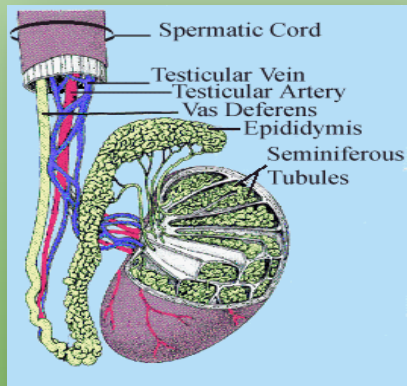


Experimental

## PRE-WEANING



- Sertoli cell multiplication ceases at 20-25 wk of age in bulls, final testes size likely determined in pre-weaning stage. Superior nutrition augment gonadotropin secretion (FSH), which result in early puberty and spermatogenesis.



## POST-WEANING TO 30-60 DAYS PRE-BREEDING

- Diet fed for slow gain in bulls (32 kg during 112 d, ADG-285g) resulted in delayed appearance of motile sperm in the ejaculate, retarded testicular growth, smaller seminiferous tubules, and reduced concentrations of testosterone in peripheral blood serum and testicular tissue, than those fed to gain more rapidly (66 kg during 112 d, ADG-590g).
- Additional dietary energy accelerates pre-pubertal development, but beyond a limit there is no positive effects.
- Limiting nutrient intake of pre-pubertal bulls decreased
  - scrotal circumference and serum testosterone
  - testicular size
  - testicular testosterone activity
  - semen volume and total sperm numbers



## CONDITIONING PRIOR TO BREEDING

- Yearling bulls BCS should be around 5.5 to 6.5 (9 point scale) at the start of the breeding season.
  - Over-conditioned bull need to gradually kept on reduced plane of nutrition
  - Below-conditioned bull need to gradually put on higher plane of nutrition
- Growing yearling bulls earlier maintained on high-energy concentrate-based diet need to be cycled down from that high plane of nutrition, otherwise it will result in more scrotal fat deposition and hamper sperm synthesis.
- The conditioning period should be around 60 days as mature sperm is produced over a 60-day period before ejaculation; nutritional effects of over- or under-feeding on sperm quantity and quality will have some carryover effect.

# **NUTRITIONAL REQUIREMENTS FOR BREEDING BULLS**

10/18/2014

## DAILY NUTRIENT REQUIREMENTS OF GROWING AND MATURE BULLS

Body wt (kg)	gain/da y (g)	DM/da y (kg)	C.P. (g)	TDN (kg)	Ca (g)	P (g)	Vit. A (1000 IU)
<b>Growing bulls</b>							
100	750	2.8	390	1.9	11	8	4
150	750	4.3	460	2.7	15	11	6
200	750	5.7	530	3.4	18	14	8
250	750	7	610	4	21	16	10
300	750	8.2	680	4.6	23	17	13
350	750	9.3	760	5.2	24	18	15
400	700	10.2	820	5.7	25	19	17
450	600	10.4	875	5.8	26	20	19
500	400	10	885	5.6	26	20	21
550	250	10	845	5.6	25	19	23
600	100	9.8	800	5.5	24	18	26
<b>Maintenance of mature breeding bulls</b>							
500	-	8.3	640	4.6	20	15	21
600	-	9.6	735	5.4	22	17	26
700	-	10.9	830	6.1	25	19	30

\* Source: Ranjhan, S.K (1980). Animal nutrition & feeding practices in India, 2nd Ed., p196-212



# NUTRIENT REQUIREMENTS FOR MAINTENANCE AND GAIN IN YOUNG AND MATURE BULLS

Body Weight, kg	300	400	500	600
<b>Maintenance Requirements</b>				
NE (Mcal/d)	6.38	7.92	9.36	10.73
MP (g/d)	274	340	402	461
CP (g/d)	<b>408</b>	<b>506</b>	<b>598</b>	<b>686</b>
Ca (g/d)	9	12	15	19
P (g/d)	7	10	12	14
<b>Growth Requirements</b>				
ADG (Kg/d)	MP/CP Required for Gain, g/d			
0.5	158/235	145/216	122/182	100/149
1.0	303/451	272/405	222/330	175/260
1.5	442/658	392/583	314/467	241/359
ADG (Kg/d)	(NE, Mcal/d) Required for Gain			
0.5	1.72	2.13	2.52	2.89
1.0	3.68	4.56	5.39	6.18
1.5	5.74	7.12	8.42	9.65
ADG (Kg/d)	Calcium Required for Gain, g/d			
0.5	12	10	9	7
1.0	23	19	16	12
1.5	33	27	22	17
ADG (Kg/d)	Phosphorus Required for Gain, g/d			
0.5	5	4	3	3
1.0	9	8	6	5
1.5	13	11	9	7

**1 kg TDN = 4.4 Mcal DE.**

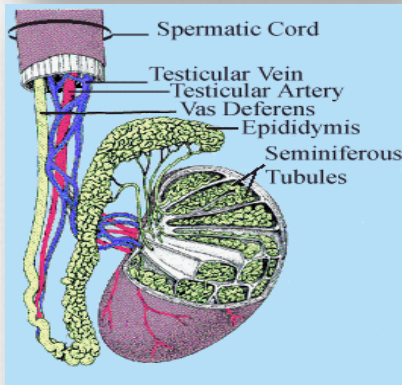
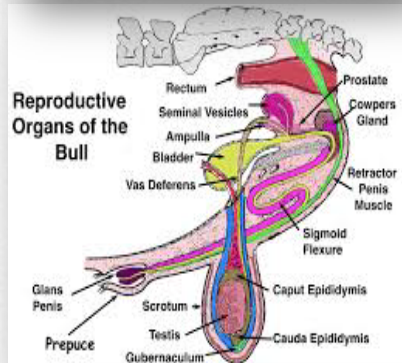
DE Mcal/kg = TDN% x .01 x 4.4, ME Mcal/kg = DE Mcal/kg x .82; CP (g/d) = MP/0.672 (g/d), NRC 2000

## Mineral and vitamin Requirements of breeding bulls

Mineral/Vitamins	Unit	Growing and Finishing Bulls
<b>Magnesium</b>	%	0.10
<b>Potassium</b>	%	0.60
<b>Sodium</b>	%	0.06-0.08
<b>Sulfur</b>	%	0.15
<b>Cobalt</b>	mg/kg DM	0.10
<b>Copper</b>	mg/kg DM	10.00
<b>Iodine</b>	mg/kg DM	0.50
<b>Iron</b>	mg/kg DM	50.00
<b>Manganese</b>	mg/kg DM	20.00
<b>Selenium</b>	mg/kg DM	0.10
<b>Zinc</b>	mg/kg DM	30.00
<b>Vitamin D</b>	IU/kg DM	275

NRC 2000

## EFFECT OF DIETARY ENERGY LEVEL ON BULL REPRODUCTION



- Studies using Holstein bulls have shown that low energy intake beginning early in life can delay puberty, and, if severe enough, can permanently impair sperm output.
- Diets with high levels of energy and diets those resulting in extreme weight loss can adversely affect libido of yearling and mature bulls
- Additional dietary energy enhanced puberty via enhanced testicular function, as measured by increased serum testosterone, testicular testosterone, Leydig cell size (produces androgen hormone) and sperm production
- High levels of energy have been shown to impair sperm output and semen quality of 2-yr-old Hereford bulls as fat deposition around scrotum decreases thermoregulation which subsequently decreases sperm synthesis and seminal quality

## SCROTAL FAT DEPOSITION HAMPERS SPERM SYNTHESIS



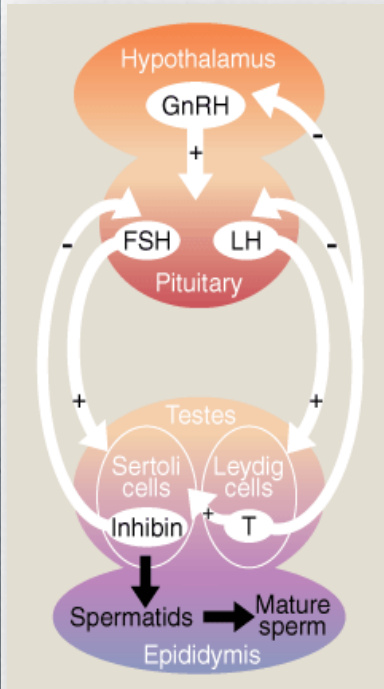
Anatomical dissection of Scrotum

## EFFECT OF DIETARY PROTEIN LEVEL ON BULL REPRODUCTION



- High protein (14.45% CP) rations had significantly larger scrotal circumference, greater body weight, higher average daily gains, higher body condition score, higher volume of semen, sperm motility, semen concentration and more total spermatozoa than those on low protein diets (8.51% CP).
- Reduced CP% in diet resulted in decreased weight of testes, epididymis and seminal glands. It decreased thickness and diameter of seminiferous epithelium and tubules, respectively.

## EFFECT OF NUTRITION ON EARLY GONADOTROPIN RISE (EGR)



- EGR is a period of 8-20 wk of age in calves during which there is increase of gonadotropin secretion (LH), characterize the pre-pubertal period
- After 20 wk of age, gonadotropin decreases, though level of testosterone still increases
- Bulls with restricted nutrition during calf-hood had a lower EGR and suppressed LH secretion. Low nutrition delays testicular development and increase age at puberty
- Reproductive function in bulls could be maximized by providing high nutrition during calf-hood and adequate nutrition in the post-weaning period.

# **ROLE OF MINERALS AND VITAMINS IN BULL NUTRITION**

10/18/2014

## Mineral deficiency



- Ca (5-20%)
- Ca (21-40%)
- Ca (41-58%)
- P (4-20%)
- P (21-35%)
- P (36-65%)
- S (15-25%)
- S (26-50%)
- S (51-61%)
- Cu (5-20%)
- Cu (21-40%)
- Cu (41-65%)
- Zn (20-40%)
- Zn (41-60%)
- Zn (61-75%)
- Mn (25-35%)
- Mn (36-50%)
- Mn (51-66%)

Mineral deficiency in the ration of animals in different states of India



## Mineral Deficiency in Different States

Deficiency range (%)	Calcium			Phosphorus			Sulphur			Copper			Zinc			Manganese		
	5.0-20.0	21.0-40.0	41.0-58.0	4.0-20.0	21.0-35.0	36.0-65.0	15.0-25.0	26.0-50.0	51.0-61.0	5.0-20.0	21.0-40.0	41.0-65.0	20.0-40.0	41.0-60.0	61.0-75.0	25.0-35.0	36.0-50.0	51.0-66.0
AP			Yes		Yes							Yes			Yes		Yes	
Arunachal Pradesh			Yes	Yes						Yes				Yes			Yes	
Assam			Yes		Yes							Yes	Yes					
Bihar	Yes			Yes					Yes	Yes			Yes					
Gujarat			Yes			Yes		Yes			Yes				Yes	Yes		
Haryana			Yes		Yes							Yes		Yes				Yes
Himachal Pradesh			Yes	Yes						Yes			Yes				Yes	
Karnataka			Yes	Yes								Yes			Yes			
Kerala		Yes				Yes			Yes		Yes			Yes				
Maharashtra	Yes				Yes							Yes	Yes					
MP			Yes	Yes							Yes			Yes				Yes
Odisha		Yes			Yes					Yes			Yes				Yes	
Punjab			Yes			Yes	Yes				Yes				Yes			
Rajasthan		Yes				Yes		Yes		Yes				Yes				
Sikkim			Yes	Yes								Yes	Yes					Yes
Tamil Nadu			Yes		Yes							Yes		Yes				
Tripura			Yes		Yes						Yes		Yes					Yes
UP			Yes			Yes						Yes				Yes		
Uttarakhand			Yes		Yes						Yes				Yes			Yes
WB			Yes		Yes						Yes			Yes				Yes

## AFFECT OF IMBALANCES OR DEFICIENCIES OF MINERAL NUTRITION ON BODY SYSTEMS

- **Immune System:** Copper, Zinc, Iron and Selenium
- **Energy Production:** Magnesium, Phosphorus and Manganese
- **Hormone System:** Sulphur, Zinc & Iodine
- **Vitamin Production:** Cobalt, Sulphur
- **Blood Production:** Copper and Iron
- **Enzyme Systems:** Zinc, Copper, Potassium, Manganese, Magnesium, Iron, Calcium and Molybdenum
- **Skeletal System:** Calcium, Magnesium, Zinc, Manganese and Phosphorus

- Zinc is essential for spermatogenesis. Zinc is involved in control of motility along with ATP
- Zn affects the production and secretion of testosterone, insulin and adrenal corticosteroids. As an integral component of over 300 enzymes, Zn is associated with numerous biological processes.
- Under developed testis is observed in Zn-deprived bull calves
- Zinc supplementation increased ejaculate volume, sperm concentration, percent live, and percent motility in bulls
- Copper deficiency can result in reduced libido, infertility and central nervous system abnormalities in offspring.
- Newborns are very dependent on copper acquired during the prenatal period since copper levels in milk are poor. Therefore, proper copper nutrition in gestating females is critical to body stores in newborns.

- Most of the selenium found in the testes is associated with phospholipid hydro peroxide glutathione peroxidase, which is an antioxidant that protects the cells from oxidative stress
- Se deficiency result in reduced semen viability
- Act as antioxidant along with Vitamin E.
- Se in association with thyroxin regulates metabolism and reproduction.
- Help in sperm capacitation which results increased influx of Ca through plasma membrane. This process assist fusion of the plasma membrane and the outer acrosomal membrane and the subsequent initiation of the acrosome reaction
- Ca, Magnesium and Manganese is important for sperm motility.

## ROLE OF VITAMINS

- Vitamin A deficiency include inhibition of spermatogenesis, reduction in testicular size, and decline in testosterone.
- Bulls fed diets deficient in vitamin A have delayed puberty, reduced libido, and reduced spermatogenesis
- Vitamin E deficiency has a deleterious effect on germ cell proliferation. Effect of vitamin E occurs directly or indirectly on the regulation of intra-testicular factors which regulate specific steps of germ cell development.
- In the male rat, vitamin E deficiency causes a degeneration of the germinal epithelium.

## BULL SUPPLEMENT DEVELOPED BY NDDDB

- A bull supplement developed by NDDDB is now commercially produced by IIL, Hyderabad under the brand name

### “Nandi Bull Supplement”

It contains chelated minerals, coated vitamins and herbs.

- Feeding trials on bull supplement were organized at ABC, Salon and SAG, Bidaj and BAIF's Bull Stations.
- On feeding the supplement, there was average increase in semen doses by about 329 per bull per month at SAG, Bidaj, 476 at ABC, Salon and 800 at BAIF.
- In addition, there was also improvement in sperm plasma membrane integrity and per cent intact acrosomes
- The supplement is available in packets of 250 g, each of the packets required to be fed daily per bull.

**EFFECT OF FEEDING BULL SUPPLEMENT ON QUANTITY AND QUALITY OF SEMEN PRODUCTION IN BREEDING BULLS (n=9) AT BAIF, URULI-KANCHAN, PUNE**

Sl. No.	Particulars	Average value before feeding the supplement for 3 months	Average value after feeding the supplement for 6 months	Change
a.	<b>Quantitative parameters</b>			
1	Av. semen doses produced (No./B/M)	3714 ±128	4514 ±213	Increased by 21.5%
2	Av. increase in semen doses production over previous year (No./B/M)		800	
b.	<b><i>Qualitative parameters</i></b>			
1	Plasma membrane integrity by HOST test (%)	54.40 ±0.78	57.40 ±0.65	Increased by 5.51%
2	Acrosome integrity test (%)	73.70 ±0.37	77.30 ±0.20	Increased by 4.88%
3	Morphological abnormality (%)	16.56 ±0.28	14.50 ±0.32	Decreased by 12.43%

HOST=Hypo-Osmotic Swelling Test

## CONCLUSIONS

A planned and scientific approach in nutritional management can upgrade the reproductive quality of breeding bulls. Bulls fed as per their actual requirement since calf-hood achieve the puberty in right time and have large scrotal circumference and higher gonadotropic hormone release, which result in healthy and fertile sperms.



## RECOMMENDATIONS AND SUGGESTIONS

- Individual feeding should be practiced.
- Calf should be provided with calf starter for early rumen papillae growth.
- Periodic animal weight recording.
- Periodic testing of feed and fodder for their chemical composition and mineral contents.
- Ration should be formulated based on requirement of individual animal, considering chemical composition and mineral contents of the existing feeds and fodders
- Feed Bull Supplement for getting higher No. of semen doses



10/18/2014

## CONDITIONING PRIOR TO BREEDING

Condition	BCS	Description
Thin	1	Severely emaciated. All ribs and bone structure easily visible and physically weak.
	2	Emaciated, similar to 1 above but not weakened. Little visible muscle tissue.
	3	Very thin, no fat on ribs or brisket, and some muscle still visible. Back easily visible.
Borderline	4	Thin, with ribs easily visible but shoulders and hindquarters still showing fair muscling. Backbone visible.
Optimum	5	Moderate to thin. Last two or three ribs can be seen. Little evidence of fat in brisket, over ribs or around tailhead.
	6	Good smooth appearance throughout. Some fat deposition in brisket and over tailhead. Ribs covered and back appears rounded.
	7	Very good flesh, brisket full, tailhead shows pockets of fat, and back appears square due to fat. Ribs very smooth.
Fat	8	Obese, back very square, brisket distended, heavy fat pockets around tailhead, and cow has square appearance due to excessive fat. Neck thick and short.
	9	Rarely seen. Very obese. Description of 8 taken to greater extremes. Heavy deposition of udder fat.

- Yearling bulls BCS should be around 5.5 to 6.5 (9 point scale) at the start of the breeding season.
  - Over-conditioned bull need to gradually kept on reduced plane of nutrition
  - Below-conditioned bull need to gradually put on higher plane of nutrition
- Growing yearling bulls earlier maintained on high-energy concentrate-based diet need to be cycled down from that high plane of nutrition, otherwise it will result in more scrotal fat deposition and hamper sperm synthesis.
- The conditioning period should be around 60 days as mature sperm is produced over a 60-day period before ejaculation; nutritional effects of over- or under-feeding on sperm quantity and quality will have some carryover effect.

## Economic analysis on feeding the *Nandi Bull Supplement* at BAIF, Pune

Sl. No.	Particular	Unit
1.	Cost of one semen dose (approx.)	Rs.10
2.	Average monthly increase in semen doses	800 nos.
3.	Daily feeding cost (*Selling price by IIL) per dose	Rs. 80
5.	Per month feeding cost	Rs. 2400
6.	Income from additional semen doses	Rs. 8000
7.	Net saving per bull per month	Rs. 5600

\*Present selling price of Nandi Bull Supplement by IIL, Hyderabad

10/18/2014