**CHAPTER: 2**

**REVIEW OF LITERATURE**

**EXPERIMENT: 1**

**Proximate Analysis**

A method for the quantitative analysis of the different macronutrients in feed is the Weende or proximate analysis, based on the Weende analysis that was developed in 1860 by Henneberg and Stohmann in Germany (Henneberg and Stohman, 1860)

**Definition**

Proximate Analysis is a way of partitioning of nutrient compounds in a feed into six categories based on the chemical properties of the compounds. The six categories are:

1. moisture
2. ash
3. crude protein (or Kjeldahl protein)
4. crude fiber
5. crude lipid or crude fat and
6. nitrogen-free extracts (digestible carbohydrates)

This analysis was an attempt to duplicate animal digestion. After extracting the fat, the sample is subjected to an acid digestion, simulating the acid present in the stomach, followed by an alkaline digestion, simulating the alkaline environment in the small intestine. The crude fiber remaining after digestion is the portion of the sample assumed not digestible by monogastric animals. In the proximate analysis of feedstuffs, Kjeldahl nitrogen, ether extract, crude fiber and ash are determined chemically. The determination of nitrogen allows the calculation of the protein content of the sample.

It is important to remember that proximate analysis is not a nutrient analysis, rather it is a partitioning of both nutrients and non-nutrients into categories based on common chemical properties (Analytical technique in aquaculture research)

**2. CHEMICAL COMPOSITION OF FEED INGREDIENTS**

**2.1. Proximate composition**

Sen and Ray (1971) has estimated the composition in maize 10.55, 1.90, 4.39, 80.66 and 1.94 per cent CP, CF, EE, NFE and TA respectively. Sen *et al.* (1978) reported the per cent composition of maize as 11.10, 1.90, 4.40, 80.70 and 1.90 for CP, CF, EE, NFE and TA respectively. Sharma (1990) recorded the CP, CF, EE and TA content of maize as 8.50, 2.50, 3.30 and 1.80 per cent respectively, while Aufrere *et al.* (1991) recorded these values as 10.70, 3.70 and 2.10 per cent for CP, CF, EE and TA respectively. Bhatt (1993) reported the values for CP, CF and EE as9.00, 2.50 and 3.20 per cent respectively while Katoch (1996) recorded the values of CP, EE, CF, NFE and TA as 9.00, 3.00, 3.10, 79.60 and 5.30 per cent respectively. Gupta (2003) reported the values for CP, CF, EE and Ta to be 9.00, 3.11, 3.00 and 5.31 per cent respectively. Katoch (2009) reported the CP, CF, EE and TA values of maize as 9.87, 2.20, 3.90 and 1.55 per cent respectively. Similarly, Chawla (2010) reported the CP, CF, EE and TA to be 9.50, 2.95, 3.25 and 2.01 per cent respectively. Sharma (2010) reported CP, CF, EE and TA values as 9.50, 2.95, 3.25 and 2.01 per cent respectively. Shama (2011) reported CP, CF, EE and TA values as 9.50, 2.95, 3.25 and 2.01 per cent respectively. Goswamy (2011) reported CP, CF, EE and TA values of maize as 7.15, 3.65, 3.65 and 2.48 per cent respectively.

For proximate and vitamin composition Davis *et al*.(1981) analyzed wheat’s from five market classes with four subclasses of white wheat, comprising 406 samples, 231 varieties, and representing three crops years and 49 growing lactations were evaluated. All values except moisture were expressed on a dry weight basis. Moisture had a range of 7.8-14.8% , with an overall means of 11.4 ±0.23%. Protein had a range of 8.3± 19.3%, with an overall mean of 13.85 0.16%. Ash content ranged from 1.17 to 2.96% with qn overall mean of 1.8± 0.23%.Carbohydrate content (nitrogen- free extract) ranged from 65.4 to 78.9%, with an overall mean of 72.4± 0.18%.

Sharma (1990) reported the percentage CP, CF, EE and TA in soya flakes to be 47.70, 6.80, 1.20 and 7.00 respectively while Bhatt (1993) reported these values to be 47.50, 6.90, 3.20 and 7.00 respectively and Katoch (1996) reported the values in soya flakes as 42.10, 4.00, 45.90 and 7.00 per cent for CP, CF, NFE and TA respectively. Gupta (2003) reported the values for CP, CF, EE and TA tobe 42.63, 3.91, 1.00 and 7.04 per cent respectively, in soya flakes. Ambatkar (2009) reported CP, CF, EE and TA values of soya flakes to be 33.85, 7.80, 1.10 and 8.41 per cent respectively. Chawla (2010) reported the CP, CF, EE and TA to be 38.50, 5.40, 2.10 and 7.54 per cent respectively. Sharma (2010) reported CP, CF, EE and TA values to be 38.50 5.40, 2.10 and 7.54 per cent respectively where as, Goswamy (2011) reported the CP, CF, EE and TA to be 45.47, 9.61, 2.12 and 7.04 per cent respectively. Shama (2011) also reported the CP, CF, EE and TA to be 38.50, 5.40, 2.10 and 7.54 per cent respectively, in soya flakes.

Negi *et al.* (1989) reported the CP content of mustard oil cake as 43.05 per cent. Sahoo (1992) reported CP, EE, CF, NFE and TA as 34.50, 1.20, 8.53, 43.11 and 12.66 per cent respectively in mustard oil cake. Dutta and Singh (1994) recorded the CP and TA content of mustard oil cake as 35.76 and 9.60 per cent respectively. Ambatkar (2009) also reported CP,CF, EE and TA values of mustard oil cake to be 35.10, 9.20, 1.43 and 9.02 percent respectively. Sharma (2010) also reported CP, CF, EE and TA values of mustard oil cake to be 32.50, 12.50, 5.86 and 6.78 per cent respectively.

Sen *et al.* (1978) reported the proximate composition values of sunflower cake as 36.40, 10.70, 11.20, 35.70 and 15.90 per cent CP, CF, EE, NFE and TA respectively. Ranjhan (1991) recorded the values as 26.20, 22.90, 20.50, 23.60 and 6.80 per cent CP, CF, EE, NFE and TA respectively. Sibanda *et al.* (1993) reported the values as 35.63, 14.80 and 95.80 per cent CP, EE and OM respectively. Sharma (1990) documented the values of per cent CP, CF, EE and TA in de- oiled sunflower cake as 34.50, 19.50, 2.20 and 10.50 respectively, whereas, Bhatt (1993) reported the values as 34.20, 20.00 and 2.10 per cent CP, CF and EE similarly Katoch (1996) reported the values as 29.60, 9.00, 8.20, 44.20, 9.00 per cent CP, EE, CF, NFE and TA. Kuldip *et al.* (1995) recorded the values as 26.75, 25.32, 6.37, 27.50 and 14.60 per cent CP, CF, EE, NFE and TA respectively in a decorticated sunflower cake. Sharma (2010) reported CP, CF, EE and TA values of it to be 25.63, 12.54, 4.45 and 9.10 per cent respectively.

Gupta (2003) reported the values of CP, CF, EE and TA to be 51.38, 2.01, 4.55 and 6.07 per cent respectively, in fish meal. Katoch (2009) also reported the CP, CF, EE and TA to be 43.1, 3.6, 4.3 and 10 per cent respectively. Similarly, Chawla (2010) reported the CP, CF, EE and TA to be 40.00, 3.54, 4.21 and 13.50 per cent respectively. Goswamy (2011) reported the CP, CF, EE and TA as 41.85, 3.30, 5.70 and 38.9 per cent respectively. Shama (2011) also reported the CP, CF, EE and TA to be 40.00, 3.54, 4.21 and 9.92 per cent respectively, in fish meal.

Thakur, S. S. and Tomar, S. K. (2004) found that the CP content of different TMRs varied from 12.2 to 12.7%, EE 1.9 to 2.6%, NDF 52.4 to 58.8%, ADF 31.7 to 36.3%, total ash 8.2 to 9.0% and acid insoluble ash between 3.2 to 3.9%.

Yusuf *et al*. (2007) conducted an experiment where physical parameters and nutrient contents of the whole seeds and seed nuts of *Tamarindus indica* L. 1753 were determined. Crude protein was between 21.25–22.20%, carbohydrate ranged from 8.9-17.10%, crude fibre was 2.33–3.82 %, crude lipid 6.94-11.43 %, in seed nuts and whole seeds respectively. Moisture contents were higher in the seed nuts 19.90 %.

By Garcia and Palmer (2007) the proximate composition was determined for the mature seeds of five varieties of winged beans, Psophocarpus tetragonolobus. The results showed that the varieties analyzed had a high protein and fat content, which was similar to soybeans. The protein content (mean ± standard deviation) of the five varieties as received was 36.0 ± 1.8%, the fat content, 15.2 ± 1.2% and the moisture content 10.4 ± 1.5%. The endosperm in winged bean variety TPT-2 was found to constitute 84% of the dry weight of the seeds, the hulls about 16%. Whole beans as received contain about 14%‘dietary fibre’ measured as neutral detergent fibre. The dietary fibre is concentrated in the hulls.

Ambatkar (2009) reported CP, CF, EE and TA values of DORB to be 14.73, 14.08, 1.28 and 9.92 per cent respectively. Sharma (2010) reported CP, CF, EE and TA values to be 14.73, 14.08, 1.28 and 9.92 per cent respectively. Goswamy (2011) reported the CP, CF, EE and TA to be 15.11, 7.54, 0.72 and 9.18 per cent respectively where, Shama (2011) reported the CP, CF, EE and TA as 14.73, 14.08, 1.28 and 3.40 per cent respectively, in DORB.

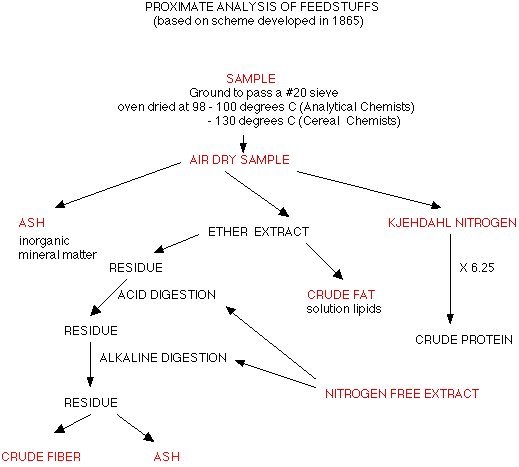
[Tambhale, G. V.](http://www.cabdirect.org/search.html?q=au%3A%22Tambhale%2C+G.+V.%22) *et al.* (2009) reported the nutrient contents of two feeds showed the values of DM, CP, CF, NEE, EE and ash as 90.65, 18.00, 17.04, 49.16, 8.9, 6.9 per cent in MADIC feed and 91.86, 14.80, 12.01, 61.0, 9.11, 2.08 per cent, respectively in homemade concentrates.

Bhuiyan *et al.* (2010) Proximate analysis of maize revealed that dry matter (DM, 980 g/kg) and ash (1.32 g/kg) content were highest in the 100 ºC samples, but crude protein (98.4 g/kg), ether extract (45.0 g/kg) and phytate-P (1.8 g/kg) content were the highest in the sundried samples.

Ogbe and Affiku (2011) conducted an experiment and found that the leaves of *Moringa oleifera* harvested from Lafia in Nasarawa State of Nigeria during the rainy season in June 2011 for proximate, mineral and phytochemical analysis. The results of proximate analysis revealed the presence of high crude protein (17.01% ±0.1) and carbohydrate (63.11% ±0.09). The leaves also contained appreciable amounts of crude fibre (7.09% ±0.11), ash (7.93% ± 0.12), crude fat (2.11% ±0.11) and fatty acid (1.69% ±0.09). The total ash content showed it contained minerals, Ca (1.91% ±0.08), K (0.97% ±0.01), Na (192.95±4.4), Fe (107.48±8.2), Mn (81.65±2.31), Zn (60.06±0.3) and P (30.15±0.5) parts per million (ppm). Magnesium (0.38% ±0.01) and copper (6.10±0.19) were the least.

Chinedu and Nwinyi (2012) conducted proximate analyses of two traditional grain legumes consumed in Eastern Nigeria- Bambara groundnut (*Voadzeia subterranean*) and African yam beans (*Sphenostylis stenocarpa*) were carried out. Bambara groundnut was found to contain 2.86±0.02% moisture, 32.40±0.02% protein, 7.35± 0.02% fat, 5.78±0.02% ash, 2.68±0.02% crude fiber and 51.78±0.02% total carbohydrates. African yam beans contained the following: 1.96± 0.02% moistuire, 37.21±0.02% proteins, 9.49±0.02% fat, 5.35±0.02 Ash, 3.55±0.02 crude fiber and 44.4±0.02% total carbohydrates.

Khalid *et al.* (2012) found that cowpea (*Vigna ungiculata* L.) seeds proximate analysis gave 75 per cent [**crude protein**](http://www.scialert.net/asci/result.php?searchin=Keywords&cat=&ascicat=ALL&Submit=Search&keyword=crude+protein), 2.6 per cent total ash and 59 per cent carbohydrate for cowpea protein isolate-A (CPIA) and 76 per cent [**crude protein**](http://www.scialert.net/asci/result.php?searchin=Keywords&cat=&ascicat=ALL&Submit=Search&keyword=crude+protein)**,** 2.3 per cent total ash and 13.1 per cent carbohydrate for Cowpea Protein Isolate-B (CPIB).The protein percentage of the seed was found to be 22.3 per cent in Whole Cowpea Flour (WCF) and 26 per cent in Dehulled Defatted Cowpea Flour (DDCF), protein isolates showed 75 and 76 per cent for CPIA and CPIB, respectively. The minimum protein solubility for CPIA was at pH 5.0 and for CPIB at pH 4.0. Total protein isolate studied showed good solubility in both acid and alkaline pH regions. For water and oil absorption capacity, DDCF gave 1.3 ml water g-1 sample and 1.04 ml oil g-1 sample, respectively; while CPIA gave 2.10 ml water g-1 sample and 1.93 ml oil g-1 sample, CPIB gave 2.33 ml water g-1 sample and 2.37 ml oil g-1 sample. Thus CPIA and CPIB showed better performance than DDCF with respect to these properties. The highest Emulsifying Capacity (EC) was observed at pH 12.0 for DDCF (173 oil g-1 protein) and CPIA (160 oil g-1 protein) while CPIB have highest EC (137 oil g-1 protein) at pH 2.0 The emulsion capacity for both cowpea protein isolates (CPIA and CPIB) was higher at pH 7.0 compare to value obtained from DDCF. Least gelation concentration for Dehulled Defatted Cowpea Flour (DDCF) and both Cowpea Protein Isolates (CPIA) and (CPIB) was noted at 12.0 per cent (w/v) at both pH 4.0 and 7.0

**Fig 1:** Flow chart of proximate analysis of feed stuff([Analytical techniques in aquaculture research](http://www.aquaculture.ugent.be/Education/coursematerial/online%20courses/ATA/index.htm)).

**EXPERIMENT: 2**

**2.2. Animal Production**

**2.2.1. Animal feeding and growth performances**

In an experiment conducted byTommervik and Waldern (1969) withgrain rations containing 95.7% of either wheat, corn, barley, milo, oats, or a control mixed grain ration were compared in digestion, lactation, and acceptability trials. In the lactation trial, alfalfa hay and grain were fed in an approximate 55:45 ratio. In the acceptability trial, hay was restricted to 1% of body weight and grain was fed *ad-lib.* Feed intake data and visual observations in the acceptability trial indicated that Milo, followed by Oats, was the most acceptable of the grain rations, whereas corn was the least acceptable. Results of both trials indicated that although there were some differences in acceptability of the grain rations when forage was restricted, under a 45:55 grain-to-hay ratio the six rations were similar in effect on milk production when the individual grain represented 95% of the concentrate mixture.

A feeding trial byWaldern and Cedeno (1970)with grain rations consisting of 98% barley, 98% wheat mixed feed, and a control mixture of barley, wheat, peas, and cottonseed meal, fed in meal and pelleted forms, were compared in digestion, lactation, and acceptability trials. Alfalfa hay was fed as the only roughage with each grain mixture at a 55:45 ratio in the lactation and digestion trials and at a 30:70 ratio in the acceptability trial. Digestibility of dry matter, energy, and total digestible nutrients content of wheat mixed feed rations were lower than barley or control rations. Fed as a meal, wheat mixed feed was consumed at a lower rate than all other grain rations (P < .05) in the acceptability trial.

Voluntary dry matter intake in ruminants determines the total energy consumption. Rahman *et al*. (1998) reported that crossbred calves fed on identical diets supplemented with probiotics mixture showed higher total DM intake. If diet contains higher proportion of concentrates, then voluntary feed intake of roughage is reduced (Brent *et al.,* 1961; Woods and Rhodes, 1962; Donefer *et al.,* 1963; Montgomery and Baumgardt, 1965). A decrease in DM intake was observed by increasing the level of maize in the diet of Holstein heifers and lamb (Montgomery and Baumgardt, 1965). Wagner *et al.* (1990) studied the effect of supplementing corn or wheat based diet with yeast culture (1 g/kg DM) on DM intake and weight gain using 48 Holstein calves at approximately 3 weeks of age. The feed intake, weight gain and feed efficiency were not affected by supplementing yeast.

In an experiment by Kumar *et al.* (2001), fifteen crossbred male calves (10-12 months) were randomly divided into three equal groups of 5 each on body weight basis. Control group (T1) was fed on groundnut cake based concentrate mixture, whereas, in the concentrate mixture of group T2 and T3, protein of groundnut cake was replaced with de-oiled sunflower cake at the rate of 33 and 66 percent, respectively. After experimental feeding of 105 days, a metabolism trial of 7 days duration was conducted. Daily body weight gain (g) in group T1 was highest (533.3) as compared to T2 (503.3) and group T3 (606.7), however, variation among groups was not significant. DM intake in term of kg/100 kg body weight, digestibility co- efficient of nutrients except EE, as well as DCP and TDN did not differ significantly among the various groups. Lower digestibility of EE was observed in group T3 than that in group T1. All the experimental animals were in positive nitrogen balance and retention of N (as % intake) remained similar among groups.

An intensive survey was conducted by Singh *et al.* (2004) in Tarikhet Block of AImora district of Uttaranchal comprising of 150 farmers of 17 villages, for assessing the availability and ingredient proportion of concentrate mixtures. Results revealed that preparation of concentrate mixtures by farmers was mostly dependant on locally available feed resources like wheat, minor millet, rice, soybean and bhat. About 95 % farmers used wheat atta (flour) as major ingredient of concentrate and 5.3 % farmers were using purchased pashu ahar (compound feed) for only productive animals. Availability of homemade concentrate was 597,664 and 847 g/d/household under small, medium and large farmers, respectively and compound feed was 41, 54 and 263 g/d/household, respectively thus the availability of concentrate mixture was increased with the size of land holding. Highest availability of concentrate (0.863 kg) supply was in the month of January, which was represented by monthly availability.

A study was taken by Das and Singh (2004) to assess the effect of replacement of groundnut cake (GNC) by berseem (*Trifolium alexandrium*) on performance of calves. 15 crossbred male calves (3-6 months old of 75.6±3.4 kg BW) randomly divided into three equal groups were offered either wheat straw and GNC in 70:30 ratio (B0), or wheat straw, GNC and berseem in 55:15:30 ratio (B30) or wheat straw, GNC and berseem in 45:10:45 (B45) ratio on DM basis for 120 days. Wheat straw composition was low (P<0.01) in B30, followed by B45 and B0. Digestibility of DM, CF, N balance and daily gain were higher (P<0.05) in group B30 than in others groups. Body composition, energy and protein utilization efficiency and feed conversion ratio were not significantly different among the groups; however feed cost per kg grain was considerably less in group B30. It was concluded that half of the GNC could be replaced with berseem for the better growth performance.

Three complete feeds viz. without paddy straw (PS0), 15 per cent paddy straw (PS15) and 30 per cent (PS30) were evaluated by Burte *et al.* (2007) on crossbred heifers (21, divided into 3 equal groups ) through a growth trial for 70 days . The DM intake was 3.38, 3.33 and 3.42 kg/100kg BW. Significantly (P<0.05) higher average daily gain was observed in complete feed PS15 than PS30. The digestibility of nutrients except NFE was statistically similar in all groups. All the animals were in positive N, Ca, and P balances. The DCP content was similar in all the treatments, however the TDN was higher (P<0.05) in PS0 and PS15 than PS30 treatment. The cost of feed was Rs. 3.76, 3.58, 3.60 in PS0, PS15 and PS30, respectively. The complete diet comprising of 15 per cent paddy straw (PS15) supplemented with cereal bran, urea, jaggare could support optimum growth in crossbred heifers.

Tyagi *et al.* (2008) conducted an experiment with 18 crossbred male calves of similar age (8-9 months) and body weight (110-190 kg) were distributed into 3 groups of 6 each on the basis of their body weight. The calves in control groups (G1) were fed on concentrate mixture containing groundnut oil cake as a sole protein supplement, which was replaced by mustard oilcake (*Brassica campestris*) (G2) and taramira oilcake (*Eruca sativa*) (G3) respectively. Wheat straw *ad-lib* and leguminous fodder (1kg) was fed to all the calves for 90 days. Gluconapin and glucobrassica napin were the major glucosinolates of mustard oil cake, whereas, glucoerucin was the major glucosinolate in taramira oilcake. Total glucosinolates content of concentrate mixtures G1, G2 and G3 was 0, 17.59 and 17.50 mmol/g, respectively. DM intake, nutrient digestibility, N2 balance, serum T3 and T4 levels and groth rate of growing calves indicated that protein supplied by groundnut oilcake in the concentrate mixture can be replaced with mustard or taramira oilcakes without affecting the growth performance and nutrient digestibility in crossbred calves. It was concluded that glucosinolates, irrespective of their source, were not harmful at 17.50 mmol/g level in concentrate mixture for the crossbred calves.

A study conducted by Chaudhary *et al.* (2008) was conducted to test efficacy of direct fed microbials (DFM) for the improvement of performance in crossbred cattle calves reared on the diet devoid of cereal grains. 32 day old calves with average body weight of 23 kg were divided into 4 groups and feed on concentrate mixture to meet 50 per cent DM requirement and green fodder *ad-lib.* Group 1 serves as a control. The 100 ml DFM culture was fed to group 2 (curd, 108 cfu/ml). The DM intake and feed conversion efficiency were not affected due to supplementation of any of the DFM. Improved body weight gain in calves by supplementation of all 3 microbial additives was observed. The digestibility of nutrients and plane of nutrition was similar in all 4 groups at 14 weeks and 52 weeks except a significance increase in digestibility of ether extract and acid detergent fibers in *S. cerevisae* fed group at 14 weeks and 52 weeks, respectively. There were no difference among the groups in the level of lactic acid, NH3-N, total and molar proportion of VFAs, ciliated protozoa count and activities of filter papers degrading enzyme, caroxymethylcellulase, xylanase, alpha-amylase, beta-xylosidase, beta-glucosidase, alpha-glucosidase and protease at 52 weeks of age. However, microcrystalline cellulose activity was significantly higher in *L. acidophilus* fed group. The blood biochemical characteristics (plasma, glucose, serum protein, albumin and globulin) and immunological status of the calves of all the groups were similar at 52 weeks of age. It is concluded from the study that long term (first birth to one year of age) feeding of DFM improve the growth performance of crossbred cattle calves fed diet devoid of cereal grains.

A trial conducted by Rajkhowa *et al.* (2008) to find out the efficacy of different iron preparation (iron dextran, chelated iron and EHb) on the body weight gain of iron deficient anemic piglet and calves revealed significant increase in body weights of all treated piglets and calves in comparison to their iron deprived groups. The study also showed that the decrease in body weight gain in iron deprived piglets and calves were associated with the fall in blood hemoglobin levels in both the species.

A study was undertaken by Tiwari *et al.* (2008) to assess the effect of substituting concentrate mixture by UMMB in Murrah buffalo. Fifteen rumen fistulated male Murrah calves (1-1/2 years) were divided into 5 groups of 3 each. Group I was fed rice straw alone with 40 g mineral mixture daily. Group II was provided concentrate mixture to meet the requirements at maintenance level, where in group III , IV and V concentrate mixture was replaced by three types Urea Molasses Block (UMMB) ‘Ex’, ‘C’ and ‘D’ offered free choice, respectively. DM intake (kg/day) was significantly lower in group I in compare to other group due to low palatability of feeds. Non availability of starch lower the production rate of protozoa in group I. supplementation of nutrients in the form of UMMB lick increase the protozoal production rates, however, the value were lower than in group II (concentrate fed). Higher values in group II (9.1±0.6) were probably dye to the availability of starch from the ingredients which were not significantly available from UMMB. Hence, UMMB supplementation of straw based diets decreased the protozoa production rates.

Kumar *et al.* (2008) conducted an experiment with dairy animal. First lactation records (766) collected from Military Dairy Farm, Meerut, spreading over a period of 21 years i.e. from1975 to 1995 were utilize to assess the effect of season and period of calving on various growth, production and reproduction traits of economic importance in Holstein Friesian x Shahiwal half-bred. The least square means estimated were 26.92±0.18 kg, 206.70±1.05 kg, 329.73±1079 kg, 381.41± 67 kg, 962.13±6.34 days, 313.34±2.21 days and 2871.11±32.64 liter for birth weight, weight at 12 and 24 month of age, weight at first calving, first lactation rate and first lactation milk yield respectively. The heritability estimates for corresponding traits were 0.261±0.092, 0.344 ±0.11, 0.596±0.143, 0.373±0.150, 278±0.101, 0.041± 0.064, and 0.353± 0.112 for birth weight, weight at 12 and 24 months of age, weight at first calving, age at first calving, first lactation rate and first lactation milk yield respectively. The phenotypic and genetic correlation ranged from very low to very high in magnitudes. The season effect was observed non significant for all the traits except the weight at birth and 12 months of age while effect due to period was significant for all the traits under the study.

Das *et al.* (2008) conducted an experiment with heifers. All the heifers in the treated group exhibited pubertal estrus following supplemented strategic minerals while control (untreated) heifers failed to show. The mean serum calcium (Ca) and magnesium (Mg) concentrations in both treated and control group of pre-pubertal heifers showed no significant differences among different days of mineral supplementation except on day 150 of supplementation for Ca between treated and control group. A significant difference was observed in the mean serum inorganic phosphorus (Pi) concentration among different days of mineral supplementation in treated group of heifer and they overcome the critical level of serum inorganic phosphorus after day 90 of supplementation. A significantly higher value of serum Ca and pi were recorded on day of pubertal estrus. The serum Mg concentration on day of estrus was also higher with no significant variation when compared.

The effect of feeding maize-based concentrates on milk yield in cows with cost-benefit analysis was donebyKamal *et al*. (2009) at smallholder farms in four districts of northern Bangladesh. Concentrate mixtures containing wheat bran, rice polish and sesame oil cake were supplied to 40 indigenous (*Desi*) cows (20 in Group A and 20 in Group B) for 30 days before intervened feeding. Cows’ body weight, milk yield and farm income were recorded before and after maze-based concentrate supplementation. Milk production is increased by 30% for Group A and 90% for Group B. The difference in milk yield before and after supplementation of maize-based concentrate in Group B was significant (P<0.05). The cows’ average body weights in Group A increased by 4.7 kg and in Group B by 1.8 kg. In both groups, net income increased and the income increase in A was significantly (P<0.01) greater than in B. Maize-based concentrated feeding in cows led to better milk yield with good economic return.

Alam *et al*. (2009) A feeding trial conducted with 16 multiparous lactating *Desi* (indigenous) cows for 32 weeks to evaluate the effects of dhaincha (*Sesbania aculeaoluble*)ipil-ipil (*Leucaena leucocephala*) as alternative sources of protein together with urea-treated straw, fish meal, green grass and urea molasses mineral block (UMMB) on body weight, milk yield and resumption of ovarian cyclicity after parturition. Cows were grouped into four and supplied four diets. Cows in groups B (dhaincha, ipil-ipil, treated straw, fish meal and common salt), group C (UMMB and green grass), and group A (treated straw, fish meal and common salt) gained body weight 20.7 ± 2.1, 17.2 ± 1.3 and 15.4 ± 3.6 kg, respectively, over a period of 32 weeks. Non-supplemented cows (group D) lost body weight an average of 12.5 ± 5.4 kg. Among the supplemented cows, significantly (P<0.05) better weight gain was observed in group B than groups C and A.

To study the effect of different feeding regimen on growth and reproductive performance of Sahiwal heifers, eighteen Sahiwal heifers (2.5-3 years, 170.55±19.02 kg body weight) were randomly divided into three groups by Ikhar *et al.* (2011). Heifers in control (T1) group were fed concentrate mixture as per their nutritional requirement along with wheat straw *ad-lib*, whereas those in groups T2 and T3were fed same diet except that the supply of DCP and TDN were only 80 per cent and 70 per cent of requirement recommended by ICAR (1998) respectively. Reduced level of dietary DCP and TDN did not affect DM intake. The daily weight gain was significantly lower (P<0.05) in group T3 whereas the reduction was not significant in group T2 (P<0.05) in comparison to control group. Nutrient digestibility was higher (P<0.05) and fertility responses as percentage of estrus as well as conception rate were slightly higher in heifer of group T2 than those in other groups. However, due to less number of observations, conclusion could not be drawn. The effect of different feeding regimen on economic of growth revealed that the 80 percent levels was comparable to that of control group, while the 70 per cent level was a costlier means of heifer rearing. Hence, it is concluded that 20 per cent reduction in the level of DCP and TDN as compared to ICAR recommendation did not affect DM intake, growth, nutrient utilization and economic of heifer rearing adversely.

Owens and Soderlund (2012) conducted an experimentwheregrains are fed to livestock primarily to supply energy, and most of the digestible energy in cereal grains comes from starch. To maximize starch digestion by livestock, corn and sorghum grain must be processed. For non ruminants, starch from finely ground grain is fully digested, but for ruminants fed high concentrate diets, finely ground grain often causes metabolic diseases. Hence, rather than finely grinding corn, processes including steam rolling, steam flaking and fermentation (high moisture storage) are used to increase extent of starch digestion from grains fed to ruminants.