Nutritional studies on some different sources of iodine on productive performance, ruminal fermentation and blood constituents of Buffalo. 1 – Effect of two different iodine levels on productive and reproductive performance of buffalo cows.

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Abstract: This study was conducted to evaluate the effect of feeding buffalo cows on ration supplemented with two levels from iodine (I) during late pregnancy (three months before parturition) and postpartum period (six months after parturition) on nutrients digestibility, some blood constituent, birth weight of their offspring, Concentrations of immunoglobulin in colostrums, milk (yield and composition) and reproductive parameters. Eighteen buffalo cows (2-4 lactations) in late pregnancy period were selected to carry out the experimental work. The animals were divided into three similar groups (6 female buffaloes in each). Concentrate feed mixture (CFM), berseem hay (BH) and rice straw (RS) were given to animals as a control ration (I_0) without supplementation, while the other groups I_1 and I_2 received the control ration with iodine at levels of 0.3 and 0.5 mg I per kg DM intake /h/d, respectively. Results indicated that supplementation ration of buffalo cows with different levels of I had improved the digestibility of all nutrients, TDN, DCP at pre and post partum, feed efficiency, increased milk yield, 7% fat correct milk yield and its composition. Birth and weaning weight of calves in treated groups were higher than that control group. Immunoglobulin concentration in colostrums indicated higher values with animals feed supplemented rations than those fed the control. Moreover, addition of I improved RBC, WBC, Hb, PCV, plasma total protein, globulin, glucose, T_3 and T_4. Supplemented rations of buffalo cows with 0. 5 mg I/ h/ d tend to significantly ($P< 0.05$) higher in actual milk yield, 7% FCM yield, fat %, protein %, lactose %, SNF % and TS %, while supplemented with 0. 3 mg I/ h/ d appeared to the same higher trend with no significantly differences. Moreover, better feed efficiency was observed with animals fed supplemented rations. The periods required for fetal membrane expulsion was significantly reduced in I_2 group when compared to I_1 or control groups. Moreover, only control group showed a case of abortion and still birth, while treated dams delivered 100% healthy calves. Buffaloes of group I_2 had the least ($P < 0.05$) calving interval due to the shorter intervals for uterine involution, onset of the 1st postpartum heat and days open. Iodine supplementation showed significant differences among groups in studied parameters such as NSPC and CI. Mean period elapsed from calving until placenta drop significantly decreased I_2 than the control group. Generally, it concluded that I supplementation for ration of buffalo cows improved immunity, nutrients digestibility, calves birth weight and increased milk (yield and composition) and showed better feed efficiency as well as higher some traits of reproductive performance.
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1. Introduction

Buffalos are the most favored milk animal in Egypt, as most Egyptians prefer buffalo milk to cow milk because of its white color, sweet taste and high fat percentage.

Iodine is a key component in the formation of thyroid hormones that contributes to brain development during fetal life and metabolism thereafter. On the other hand, thyroid hormones are major regulators of development, metabolism and homeostasis. Studies addressed that thyroid hormones influence both aspects of development; growth. A lack of iodine indirectly influences growth rate, milk production and feed consumption. Other deficiency symptoms include poor conception rates, abortions, longer gestation periods and the birth of dead, weak or hairless calves. Moreover, pregnant animals are more susceptible to iodine deficiency than non-pregnant animals ,which in turn increase the incidence of prepartum and postpartum reproductive disorders. Also Lactating dairy cattle require more iodine than beef cattle because approximately 10% of the iodine intake is normally excreted in milk, and this percentage may increase as milk production increases.

NRC (1994, 1998, 2001) reported that the iodine requirements for dairy cows 0.5 mg/kg dry matter (DM). Sanchez (1995) reported that iodine requirement is 0.6 mg /Kg of DM for lactating cows and 0.25 for calves, and growing heifers. Although cattle can tolerate iodine far in excess of their requirements , a level of 50 mg I/ Kg of DM has been suggested as the maximum tolerable level. Who added that low levels of iodine in the diet affect reproduction of cows , causing irregular oestrous cycles, low conception rates as well as desorbed fetuses, abortions, stillbirths or calves may be born blind, weak or with goiter. Male fertility may be also affected, decreasing libido and semen quality. Severe iodine deficiency may reduce milk yield or growth rate. Georgievskii et *al.* (1990) found that the principal function of iodine is determined by its presence in the thyroid hormones. These hormones are known to regulate basic metabolism , consumption of carbohydrates, proteins and fats, and heat formation processes, and to affect growth , development and the reproductive function. The effect of hormones on metabolism involves synthesis of respiratory and other enzymes, which affect intracellular processes of oxidation, oxidative phosphorylation and protein synthesis. Gaffarov and Saliev (1979) indicated that supplement of iodine for cow rations increased the digestibility of all nutrients . Gasanova (1985) reported that increasing the dietary level of iodine from basal values 0.11-0.16 mg /Kg DM to 0.59 - 0.65 mg / Kg DM improved feed utilization for milk production. Hetzel(1990) reported that iodine deficiency disorders is the term now used, instead of goiter (enlarged thyroid), to denote all the effects of l deficiency on growth and development.

Hoption (2006) reported that thyroidal hormones play a major role in the growth and development of brain and central nervous systems, control of several metabolic processes including carbohydrate, fat, protein, vitamin and mineral metabolism. Iodine deficiency affects reproductive capacity, brain development and progeny as well as growth. Smith and Chase (2004) reported that early research confirmed that nutrition played an important role in reproduction, but in most cases severe nutritional deficiencies were required to cause reproductive problems. They also said that reproduction is influenced through iodine's action on the thyroid gland. Inadequate thyroid function reduces conception rate and ovarian activity. Lobb and Dorrington (1992) and Monget and Monniaux (1995) reported that the animals suffer from iodine deficiency then ovary become atrophy and decrease the milk production and there will be decrease calcium absorption capacity i.e. low calcium and high phosphorus in blood. Iodine acts on the thyroid gland. Metabolic activity of body also decreases slow growth due to Iodine deficiency. If we supply iodine, increase the function of thyroid gland, maintain the balance of Ca and P level, and increase metabolic activity of body, body weight and animal come in heat early. So hormone will be less effective in Iodine deficient cow. The mechanism by which massage brings back cows ovary to function is not clearly understood, but is probably the result of activation of intrinsic ovarian factors.

Therefore, the present work aimed to study the effect of iodine dietary supplementation on birth weight of their offspring, milk (yield and composition), nutrients digestibility, immunoglobulin status, blood constituents and reproductive performance of Egyptian buffalo's cows.

2. Material and Methods

The experimental procedures:-

This study was carried out at EL-Gemmaiza Experimental Station belonging to Animal Production Research Institute, Agricultural Research Centre, Giza, Egypt. Eighteen Egyptian lactating buffalo cows (2-4 lactations) were used in this study. Animals were chosen in late pregnancy period at approximately 90 days prepartum and divided randomly into three similar experimental groups, (6 animals in each group) to evaluate the effect of using iodine in feeding buffalo cows on nutrients digestibility, some blood parameters, birth weight of their offspring, immunoglobulin status, milk yield, milk composition and reproductive parameter. The control ration consisted of concentrate feed mixture (CFM), berseem hay (BH) and Rice straw (RS)which was given to buffaloes, (I_0) without additives, while the other groups I_1 and I_2 fed the control ration supplemented with two levels of Iodine : 1st is 0.5 mg sodium iodide per kg DM intake /h/d (0.3 mg I per kg DM intake /h/d) and 2nd is 0.8 mg sodium iodide per kg DM intake /h/d /h/d (0.5 mg I per kg DM intake /h/d)respectively. I were well mixed with some of the ground concentrate feed mixture before feeding. Animals were individually fed according to Kearl (1982). The animals were left for 4 weeks (as a preliminary period) on the same diet before receiving any samples. The experimental treatments lasted nine months (three months before the expected calving date and continued up to six months of lactation period) to investigate the effect of I supplementation on productive and reproductive performance of buffaloe cows.

Management and feeding:-

All animals were housed in semi open pens until time of delivery then they were transferred to the maternity unit. Water was offered freely in water troughs except at the milking time. After delivery all buffalo cows were allowed to nurse their calves for only one week postpartum (period of colostrums intake) thereafter, the dams were transferred to the milking unit and milked twice daily at 7a.m and 5 p.m. and they were subjected to the regular managerial practices of the breeding stock. Dams were weighted before and after calving as well as their new born calves were also weight and recorded immediately after calving until weaning (90days). Milk yield was recorded. Composite and representative samples of milk (morning and evening samples) were mixed by ratio of 1% weight of milk and analyzed biweekly for fat, protein, lactose, solids non fat, total solids and ash using Milkoscan apparatus. Energy of milk was calculated by using the formula of Overman and Sanmann (1926) where energy of milk:

(Kcal) = 115.3 (2.51 +fat %).

Actual milk yield was converted into 7% fat corrected milk (FCM) using the formula given by Raafat and Saleh, (1962) as follows:

7% FCM = 0.265 milk yield +10.5 fat yield.

Two digestibility trials were carried out at 60 and180 days of the feeding trials using buffalo cows from all groups to determine the nutrients digestibility and nutritive value of the experimental rations. Acid Insoluble Ash (AIA) technique according to (Van Keulen and Young, 1977) was used as a marker for the determination of the nutrients digestibility. Digestibility of DM as well as all nutrients was determined with the following equations:

% Nutrient digestibility =100-(% DM digestibility x % Nutrient in feces) / % Nutrient in feed).

At the 60 and 180 days of the trial, fecal samples were collected from the rectum twice daily every 10 hr at 7:00 and 17:00 hr starting at the 3rd day of the collection period. Feed and fecal samples were dried, ground and kept for later analysis. Chemical composition of the different ingredients and feces samples were analyzed according to A. O. A. C. (1990).

Colostrums analysis:-

Colostrums samples were collected within one hour of parturition (first milking) from each dam at the 1st, 2nd and 3rd day postpartum for immunoglobulin studies. Determination of immunoglobulin's Ig A, Ig M and Ig G in colostrums was applied by Bovine radial immunodiffusion (RID) kit according to the procedure outlined by the manufacturer (The Binding Site Ltd, Birmingham, UK). The principle of the technique was derived from the work of Mancini *et al*. (1965) and Fahey and McKelvey (1965).

Blood sampling:-

Blood samples were collected biweekly via the jugular vein from each buffalo cows during late pregnancy (LP) and postpartum (PP) period. Count of red blood cell (RBC) and white blood cell (WBC) was determined using haemocytometer, packed cell volume (PCV%) was estimated using micro-hematocrit tube and micro hematocrit centrifuge at 10000 rpm for 5 min, while concentration of hemoglobin (Hb) was carried out using (Super+Ior®, Sahli's method) according to Sahli, (1905). Blood plasma was carefully separated after centrifugation at 4000 r.p.m. for 20 minutes, and then stored at -20 C^o until analysis for the different blood parameters. Plasma was used for determination of Glucose (Trinder, 1969), total protein (Armstrong and Carr 1964), blood urea nitrogen (Faweat and Scott, 1960), albumin (A) (Drupt, 1974), cholesterol (Kostner *et al*., 1979) and triglycerides (Schalm *et al*., 1975). Direct radioimmunoassay technique was performed for determination of progesterone, (P4) estradiol 17β, triiodothyronine (T_3) and thyroxin (T_4) hormones in representative plasma samples. Kits of ‘‘Diagnostic Products Corporation, (DCP) Los Angles, USA ’’ with ready antibody coated tubes were used according to the procedure outlined by the manufacturer.

Measurement of reproductive traits:-

During postpartum period, the reproductive tract was rectally palpated once every two days till 21 postpartum and once every three days after that in order to assess the uterine involution according to El-Fadaly (1978). All experimental buffalo cows were observed twice daily for estrous activity and buffalo cows in heat were inseminated 12 h after estrus detection. Animals were examined for pregnancy by rectal palpation after 50 days of insemination.

Immediately after parturition, the interval elapsed for complete fetal membranes drop (hour) and uterine involution period (day) were recorded. Also, the interval from calving to first detected estrus (day), service period length (day), number of services per conception (NSPC), days open, pregnancy rate (%) and calving interval (CI/day) were recorded.

6- Statistical analysis:

Data were analyzed using GLM procedures of the SAS (SAS, 1996). Means were separated by using Duncan's multiple range test (Duncan, 1955).

3. Results and Discussions

Chemical composition of feedstuffs:-

The chemical composition of CFM, BH and RS (Table 1) are within the normal ranges reported in Egypt by several workers (El–Hosseiny, *et al*., 2008 and Zeedan, *et al*., 2008 and 2010).

Nutrients digestibility and nutritive values:-

Results obtained from Table (2) indicated that digestibility of DM, OM, CF and EE was not influenced by I supplementation at 60 days. While digestibilityes of CP and NEF were significantly higher (P<0.05) for I_2 than I_0. Also, nutritive value as TDN was significantly (P<0.05) for I_2 than I_1 and I_0. At 180 days the digestibility of all nutrients and nutritive value (TDN and DCP) tended to significantly (P<0.05) increase for the I_2 compared to the I_0. These results were in agreement with those obtained by Lubin *et al*. (1979), Gasanova (1985) and Lenina (1986). Pattanaik *et al*. (2001) found that digestibility of DM, OM, CP and EE was not influenced by I supplementation and were comparable to the control values during the first metabolism trial (90 days). During the second trial, conducted at 165 days post-feeding, the digestibility of nutrients tended to increase for the I supplemented group I_{50} compared to the control, but the differences were non-significant. El–Hosseiny, *et al*. (2008) found that supplement of iodine for young camel, the digestibility of nutrients and nutritive value (TDN and DCP) tended to increase, but the differences were non-significant. Also Gaffarov and Saliev (1979) indicated that supplement of iodine for cow rations increased the digestibility of all nutrients .

The improving of digestibility of most nutrients may be due to its effect on rumen bacteria especially rumen proteolytic bacteria and increasing the number of rumen cellulolytic bacteria (Hungate, 1968 and Martinz and Church, 1969). Lawrence and Fowler (1997) reported that thyroid hormones influence the function of most organs and stimulate the basic metabolic rate through regulation of the metabolism of carbohydrates, proteins and lipids. Improvement of TDN and DCP might be due to the higher values of digestibility values of all nutrients by supplementation with different levels of I supplementation. Hoption (2006) reported that thyroidal hormones play a major role in the control of several metabolic processes including carbohydrate, fat, protein, vitamin and mineral metabolism. On the other hand, Sawal *et al*. (1996) found that digestibility of all organic nutrients decreased with female Gaddi sheep receiving iodine.

Birth weight of born calves and dams:-

Data of body weight (dams and calves) and daily gain of calves are summarized in Table (3).The dam body weight before parturition; late pregnancy (LP) was insignificant in all experimental groups. The same trend was observed with fetal fluid, but dam body weights after parturition, post-partum (PP) were significant (P<0.05). Also, fetal fluid was not significant in all treatments. Percentages of calving loss (CBW + fetal fluid) / DBW before parturition were 9.30%, 9.66% and 10.48 % for groups I_0, $I_1$and I_2, respectively. Differences between groups in Calf birth weight (CBW) and CBW / Dam post-partum were significant (P<0.05) (Table 3). Group I_2 achieved greater values of CBW / Dam post-partum, calf birth weight, weaning weight, total gain of calve and daily gain of calve than other groups. Improvement percentage was 8.62 and 12.07%for daily gain of calves. The newly born calves from treated dams I showed higher CBW, weaning weight, total gain, daily gain and better vitality in comparison with the control group. Generally the calves from treated dams showed higher CBW, CBW / Dam post-partum, weaning weight, total gain and daily gain than the control group. The supplementation has improved the thyroid function at calving and weaning in the buffaloes, increased the digestion protein, TDN (60 and 180 days), concentrations of immunoglobulin in colostrums, milk protein and milk lactose led to increase the calf birth weight and calf weaning weight. Gilles *et al*. (2009) found that the selenium and iodine administration in prepartum cows may enhance the calf immune defences by improving the maternal mineral status. Sultana *et al*. (2006) found that the highest live weight gain was found in Lugol's iodine treated group (7.09%) followed by iodide salt treated group (5.28%) and common salt treated group (4.94%).They added that the lowest live weight gain was determined in control group (No iodine treatment). They added that the reason why might be due to anabolic effect of iodine on weight gain. Hoption (2006) reported that thyroidal hormones play a major role in the growth and development of brain and central nervous systems, control of several metabolic processes including carbohydrate, fat, protein, vitamin and mineral metabolism. Iodine deficiency affects reproductive capacity, brain development and progeny as well as growth Lobb and Dorrington (1992) and Monget and Monniaux (1995) reported that the animals suffer from Iodine deficiency then decrease the milk production and there will be decrease calcium absorption capacity i.e. low calcium and high phosphorus in blood. Iodine acts on the thyroid gland. Metabolic activity of body also decreases slow growth due to Iodine deficiency. If we supply iodine, increase the function of thyroid gland, maintain the balance of ca and p level, and increase metabolic activity of body, body weight. Also, Mc Dowell, (2003) and Underwood and Suttle, (2001) found that both hormones have multiple functions in the energy metabolism of cells, in the growth, as a transmitter of nervous stimuli, and as an important factor in brain development. Also, Gasanov (1991) reported that Supplemented (injections of tetravitan and supplements of trivitan, potassium iodide, sodium selenite, calcium triphosphate, proserine, cobalt chloride or zinc sulphate) buffaloes had increased calf birth weight, decreased calving problems, increased milk yield and colostral density, and blood immunoglobulin concentrations. He added that buffaloes were deficient in selenium, cobalt and iodine which affected immune.

Concentrations of immunoglobulin in colostrums:-

As shown in table (4) concentrations of all Immunoglobulin (Ig) fractions in colostrum of buffaloes showed a descending trend with sequence sampling days after parturition. IgA, IgM and IgG were detected increasing for $I_1$and I_2 compared to I_0. IgG were significantly ($P < 0.05$) in group I_2 in comparison with other groups. The control group I_0 had minimal concentration of IgA, IgM and IgG than other treated groups. The supplementation has improved the thyroid function at calving in the pregnant cows, increased the digestion both protein and TDN at 60 days led to increase immunoglobulin. Northeim *et al*. (1985) reported that the immune status of the newborn calves is dependent upon the passage of immunoglobulins from dams to the calves through the ingestion of colostrum and its subsequent absorption from small intestine. Nocek *et al*. (1984) demonstrated that IgG has been related to pre-weaning growth. Consumption of colostrum is essential to provide animals with the antibodies and other proteins that calves need to stay healthy. The amount of colostrum and immunoglobulin, or IgG consumed determines amount of passive immunity and resistance to disease. When calves consume insufficient amounts of IgG from colostrum within the first 24 hours of life, calves are much more susceptible to developing disease and possibly dying. A major reason that pre-weaning mortality is higher than optimum (defined as less than 5% of calves born alive) is due to inadequate IgG intake (Quigley, 2005).

Estimates of Ig in the current study are greater than those obtained by Salama *et al.* (1997) who observed that Ig contents in colostrum of Egyptian buffaloes at 24, 48 and 72 hr after calving were 26.1, 20.0 and 16.4 mg/ml in premiparous and 26.0, 14.3 and 10.9 in pluriparous buffaloes. Gasanov (1991) reported that Supplemented (injections of tetravitan and supplements of trivitan, potassium iodide, sodium selenite, calcium triphosphate, proserine, cobalt chloride or zinc sulphate) buffaloes had decreased calving problems, increased colostral density, and blood immunoglobulin concentrations. Who added that buffaloes were deficient in selenium, cobalt and iodine which affected immune.

Generally Subsequently, the amount of IgG in dam's colostrum depended mainly upon prepartum administration of immunopotentiators, and in calves depended mainly upon consumption of colostrum directly after parturition.Also, iodine supplementation may be improved the thyroid function led to increase concentrations of immunoglobulin in colostrums.

Milk yield and composition:-

Data presented in Table (5) showed that the actual milk, milk composition percentage and yields, 7% fat corrected milk (7% FCM) yield and milk energy (Kcal / Kg milk) of lactating buffalo cows. The actual milk yield (AMY) and 7% fat corrected milk (7% FCM) yield of dairy buffalo cows were significantly ($P< 0.05$) higher of I_2 than that of I_0. Similar results were obtained by Monastyrev (1980), Gasanova (1986), Kobeisy and Shetaewi (1992), Kobeisy *et al*. (1992) and Allam *et al*. (2003) they reported that addition of I to the ration of lactating cows and buffaloes increased milk production and 4 or 7% fat correct milk yield. Improvement and increasing in milk yield was observed with animal gropes fed supplemented ration with I, being 14.94 % and 28.67% with groups I_1 and I_2, respectively. The same increasing trend was shown with 7% FCM yield. The respective values were 16.00% and 45.5. Also Golubev and Sedov(1984), Drebickas *et al*.(1993) and Androsova (1994) showed that addition of potassium iodide to ration of lactating cows increase milk production by 10 – 18%.

The increase in milk yield with I supplementation may be due to higher nutrients digestibility at 180 days (Table 2) and increase in T_3 and T_4. Hoption (2006) reported that thyroidal hormones play a major role in the control of several metabolic processes including carbohydrate, fat, protein, vitamin and mineral metabolism. Georgievskii *et al.* (1990) reported that the principal function of iodine is determined by its presence in the thyroid hormones. These hormones are known to regulate basic metabolism, consumption of carbohydrates, proteins and fats the effect of hormones on metabolism involves synthesis of respiratory and other enzymes, which affect intracellular processes of oxidation, oxidative phosphorylation and protein synthesis. Also, Lawrence and Fowler (1997) reported that thyroid hormones influence the function of most organs and stimulate the basic metabolic rate through regulation of the metabolism of carbohydrates, proteins and lipids. Gasanova (1985) reported that increasing the dietary level of iodine from basal values 0.11-0.16 mg /Kg DM to 0.59 - 0.65 mg / Kg DM improved feed utilization for milk production.

Percentages and yield milk constituent (fat, protein, lactose, SNF, TS and milk energy) were significantly ($P< 0.05$) higher in groups I_2 than those of I_0 in (Table 5). Allam *et al*. (2003) reported that supplementing ration with iodine significantly ($P< 0.05$) increase percentages fat, protein and energy contents. Angelow *et al*. (1993) reported that the differences between control and iodine (0.2 mg / kg as KI) for daily yield of milk fat and protein were significant. Todorova *et al.* (1995) found that iodine deficiency decreased milk fat, protein yield of ewes. Ehlers *et al.* (1994) observed that there was trend towards higher milk protein yield which was attributed to higher thyroxin for dairy cows given diet supplemented with iodine. Kobeisy and Shetaewi (1992) found that milk fat% and milk TS% increased by iodine supplemented group in Egyptian buffaloes at mid lactation. Kobeisy *et al*. (1992) found that iodine supplementation in ration buffaloes increase percentages milk constituent (fat, protein, lactose and TS) compared the control group. On the other hand, Norouzian *et al.* (2009) pointed that no significant differences observed in all treatment by different level of iodine, for milk yield and milk composition. Also Nudda *et al*. (2009) found that milk yield and composition were not influenced by KI supplementation, but the first level of KI supplementation increased the content of milk fat significantly compared with that of the unsupplemented group.

Feed intake and feed efficiency:-

Data in Table (6) indicated that lower dry matter intake was obtained for I_1 and I_2 than that of I_0, with no significant differences among groups. Data presented in Table (6) showed that the DMI decreased with animal groups fed I_1 and I_2. Decreasing in DMI might be due decreasing intake of rice straw with there groups because of I supplementation make a favorable effect for animals to get the best ingredient from ration and also might be to higher digestibility and nutrients value for experimental rations. Norouzian *et al.* (2009) found that decrease of dry matter intake related to feeding high levels of iodine but no significant difference was observed between treatments for DMI. These results are in agreement with El–Hosseiny, *et al*. (2008), Allam *et al*. (2003) and Meyer *et al.* (2008) they found that I supplementation had no significant effect on feed intake. Total intake from both TDN and Total DCP showed no significant difference with I supplementation. Results obtained herein are in agreement with that of El–Hosseiny, *et al*. (2008) and Allam *et al*. (2003).

Feed efficiency was expressed as amount of either milk yield or 7% milk yield produced from one kg DM intake. Results obtained in Table (6) showed that the feed efficiency was significantly ($p<0.05$) higher with animal groups fed I_2 than those fed I_0 but the differences between groups fed I_0 and I_1 were not significant. Also, differences between groups fed I_1 and I_2 were not significant. Generally, iodine supplementations tend to higher feed efficiency. Improvement in feed efficiency for groups consumed I supplementation might be attributed to lower DM intake and higher milk yield.

The same previous trend was observed with feed efficiency when expressed as 7% FCM/kg DCP, being 8.89, 9.98 and 12.13 for gropes fed rations I_0, I_1 and I_2, respectively. These results are in harmony with Allam *et al*. (2003) and Lenina (1986) they reported that supplements of I for cattle improve feed efficiency compared to control groups.

Blood parameters:-

Data in Table (7) illustrated that count of (RBC and WBC), Hb and PCV were significantly ($P< 0.05$) increased on LP and PP in treatment. This effect could be due to increased thyroid hormone and functions of hormone in treated animals. These results are in accordance with shcheglov and Gruzdev, (1989), Spiridon and Hebean. (1988) and Zygmunt (1987). Bedi *et al*. (2000) found that hemoglobin tended to increase, but the differences were non-significant by using level of KI. Also, Sultana *et al.* (2006) reported that the total erythrocyte count (TEC), hemoglobin percent and packed cell volume (PCV) were increased on 60 days of post-treatment in all groups (common salt, iodide salt and Lugol's iodine) compared with control group. They added that the variation might be due to effect of iodine formulation on hemopoiesis.

As shown in Table (7) total protein, T_3 and T_4 concentrations in blood plasma of I_1 and I_2 groups were significantly (P< 0.05) greater than of I_0 within two stages LP and PP. Shetaewi *et al.* (1991) found that serum proteins tend to be higher in high treatment of KI than low of KI or control treatments. Vsyakikh *et al.* (1992) reported that total protein significantly increased during the second month of lactation in cows receiving KI. El–Hosseiny, *et al.* (2008) showed that serum total protein significantly increased by supplement of iodine. The increase in plasma protein with iodine addition may be due to the increase in protein synthesis, digestion of protein at the 60 and 180 days in Table (2) and increase in T_3 and T_4. Freeman, (1983) and El-Masry and Habeeb, (1989) reported that the result of the elevation of anabolic hormone secretion that are responsible for utilization of amino acids and other physiological functions related to metabolic rate. Also, Lawrence and Fowler (1997) reported that thyroid hormones influence the function of most organs and stimulate the basic metabolic rate through regulation of the metabolism of carbohydrates, proteins and lipids. On the other hand Kobeisy and Shetaewi (1992) found that serum total proteins was lower (P<0.01) in I supplemented buffaloes compared with control. Pattanaik *et al.* (2001) found that T_3 and T_4 increased by I supplementation compared to control. Kobeisy and Shetaewi (1992) showed that iodine treated buffaloes had 40% higher (P<0.02) serum triiodothyronine than control buffalos. Khushdeep and Randhawa (2004) found that a significant elevation of plasma T_4 concentration in buffaloes treated with 2 ml of iodized (containing 375 mg iodine / ml) subcutaneously in the brisket region. Also, Rose *et al.,* (2007) found that supplementation with I was associated with higher levels of tri-iodothyronine and thyroxin in the lambs at birth. Norouzian *et al.* (2009) found that average to T_3 were 90.75, 91.125, 99.50 and 104.75 for control, the control diet plus 2.5, 5 and 7.5 mg Potassium Iodide/kg diet DM, respectively, while T_4 were 3.00, 2.675, 3.237 and 2.80 at the same treatments. In these study the increase in T_3 and T_4 concentrations with animals fed I_1 and I_2 treated animals may be due to increasing the availability of I to the thyroid to meet the increasing demand of thyroid hormone during pregnant and lactation period.

No significant difference was observed among different treatments for albumin in LP but significant difference was observed during PP period (Table7). While, significant difference was observed among treatments for globulin during LP and PP period. Also no significant difference was observed among treatments for A / G ratio during LP and PP. The increase in serum albumin and globulin with iodine addition may be due to the increase in protein synthesis, total protein in blood and digestion of protein at the 60 and 180 days as show in Table (2). Shetaewi *et al.,* (1991) founded that serum albumin tended to be higher in high iodine treatment than low iodine or control treatment. They added that serum globulin tended to be higher in iodine treatment than control treatment. El–Hosseiny, *et al.* (2008) showed that serum albumin no significant by supplement of iodine. They added that globulin was significant by supplement of iodine. On the contrary Kobeisy and Shetaewi (1992) found that globulins was lower (P<0.01) and albumin tended to be lower in I_2 supplemented buffaloes compared with control.

Data in Table (7) illustrated that glucose was significantly (P< 0.05) increased with groups fed I_1 and I_2 during PP period and it showed no significant difference during LP period. Bedi *et al.* (2000) reported that serum glucose level was significantly (P<0.01) in goats by using level of KI. Davis *et al.* (1988) found that T_4 injection (20 mg/d) for 4 days during successive 16 days experimental period increased mammary glucose uptake by 45%. Kobeisy and Shetaewi (1992) reported that serum glucose concentration was higher in iodine supplemented buffaloes than in control buffaloes. Draganov *et al.* (1991) found that supplemented diets (iodine, cobalt and copper) increased the concentration of blood glucose by 2.1 and 5.7 %. Vsyakikh *et al.* (1992) revealed that blood glucose significantly increased during the second month of lactating in cows receiving KI compared with control group. These results also probably attributed to the higher of blood plasma glucose and albumin concentration of animals fed iodine supplemented ration as shown in Table (7). It led to an increase in milk lactose synthesis and a consequent increase in milk production. This results may be due to the high demand for energy especially glucose as a main source of energy during late pregnancy. Manston and Allen (1981) reported that reduction in blood sugar level in the late pregnancy and 1 - 2 days after parturition indicates a heavy demand for glucose in late gestation and early lactation. Similar results were reported by El-Malky (2007) who found that Egyptian buffaloes blood glucose was decreased during late pregnancy and increased in the 3 months of postpartum. Significant Triglycerides was observed between treatments in LP and PP in Table (7). Kobeisy and Shetaewi (1992) showed that buffaloes treated with iodine in mid-lactation period had more 67% (P<0.05) triglycerides than control group. On the other hand, Davis, *et al.* (1988) found that was no detectable effect of T_4 injection on plasma triglycerides concentration. Lawrence and Fowler (1997) reported that thyroid hormones influence the function of most organs and stimulate the basic metabolic rate through regulation of the metabolism of carbohydrates, proteins and lipids.

Also, the effect of treatment on blood urea nitrogen (BUN) was significant ($P<0.05$), whereas treated groups had a higher means compared with untreated group in both pre and postpartum periods. This effect could be due to increased thyroid hormone in treated animals which in turn result in a slight increase in protein catabolism. Kobeisy and Shetaewi (1992) found that serum urea nitrogen tended to be slightly higher in buffaloes treated with I2 in mid- lactation period compared with control group.

Data in Table (7) showed that cholesterol was lower in I_1 and I_2 than I_0 during LP and PP. It is interest to notice the reverse relationship between T_3 and cholesterol concentrations that occurred during treatments. Shetaewi *et al.,* (1991) found that serum cholesterol concentration was 15% lower in lambs that received 80 mg KI/head/wk compared with controls. Also, Kobeisy and Shetaewi (1992) showed that cholesterol concentration was 20% less in treated group than that control group for buffaloes in mid lactation period supplemented with I_2 in diet. Kaneko (1980) reported that serum cholesterol was previously used as an index of thyroid function because hypothyroidism is generally associated with an elevation in serum cholesterol. Bergersen (1979) suggested that thyroid hormones increase cholesterol synthesis and enhance the livers ability to excrete cholesterol in the bile. But the effect on cholesterol excretion is greater than that on cholesterol synthesis; the net result is a decrease in plasma cholesterol concentration. However, serum cholesterol varies with a variety of factors unrelated to thyroid activity such as the nature of the diet, hepatic function and other factors (Kaneko, 1980).

As shown in Table (7) EST 17β concentrations in blood of I_1 and I_2 groups were significantly ($P< 0.05$) greater than that of I_0 within two stages (late pregnancy LP and Postpartum PP). Data showed that level of plasma P_4 was lower in treated groups in prepartum period than that in the control group. Concentrations of P_4 tended to change slightly during the postpartum first months where the ovaries are still inactive. This may suggest that the sharp increase of EST17 β and decrease of P_4 just before parturition was observed by Gordon (1996). Analysis of variance revealed that prepartum and postpartum P_4 concentration was affected significantly by different experimental groups. P_4 concentration tended to be high in I_2 than I_1 and I in postpartum period. This finding indicated regression of corpus luteum in all cows at parturition (El-Moghazy, 2003). It is of interest to note that, average P_4 concentration at postpartum period was tend to be high in treated groups than control group. In general, the presented data reflected that treatment lactating buffalo cows on different iodine levels did not affect P_4 profile prepartum and postpartum periods. The diminished levels of P_4 before parturition was also stated earlier by several authors (Kamonpatana *et al.,* 1981; Perera, 1981) working on buffaloes. Smith et al. (1973) reported that the decline of P_4 stimulates the uterus to be under estrogen dominance at a time when coordinated uterine contractions begin in cattle. In contrary, Nanda *et al.* (1981) noticed that P_4 levels in normal pregnant buffaloes remained almost constant from day 60 before calving to the last week of pregnancy. The importance of P_4 drop before onset of calving is to prevent the inhibitory effect of P_4 upon myometrial contraction as well as the release of oxytocin (Batra et al., 1982).

Data illustrate that the level of EST17 β increased linearly toward time of parturition in treated and untreated groups of buffalo, however clear differences were detected between both groups, whereas treated groups recorded higher EST17 β levels than control group. After delivery, concentrations of EST17 β decreased sharply in both groups of buffaloes in comparison with its level during late pregnancy. It seems likely that estradiol concentration in blood increases concomitantly with the decline in P_4 concentration (El- Wardani et al., 1998). Normal expulsion of fetal membranes requires a rise in EST-17β before calving accompanied by a gradual and sustained fall in P_4 (Prakash and Madan,1986). Moreover, normal calving requires softening and dilation of the cervix, particularly during late pregnancy due to the influence of relaxin and estrogen when P_4 dominance decline and uterine prostaglandin production is increasing (Taverne, 1992). This, P_4 decline is accompanied by a gradual increase in $PGF_2\alpha$ until 24 h before calving (Gordon, 1996).

The increase in blood studied constituents may be due to the role of iodine in improving all nutrient digestibility especially CP (Table, 2) of buffalos fed I, and also may be probably led to an increase in the absorption rate from the digestive tract, thus blood constituents of the supplemented animals reflected a corresponding increase of these values. These results are in agreement with Drebickas *et al*. (1993) who found that supplementary iodine improved chemical composition of blood in cows compared with the control diet.

Reproductive aspects:-

Mean values of some reproductive traits of the experimental dams are presented in table (8). Prepartum treatment with iodine reduced the period of fetal membrane expulsion compared to the other groups (P<0.05). Buffaloes of group I_2 had significant shorter intervals for uterine involution, onset of the 1^{st} heat and days open when compared with other groups. In consequence, group I_2 had the least (P < 0.05) calving interval (367.2±24.1 days). On the contrary to that, the control group I_0 exhibited longer time to attain its uterine involution (52.6±9.16 days) or reaching conceptive date (93.2±18.28). Buffaloes in group I_2 required only one service to conceive. Gestation periods for groups fed ration containing 0.5 mg I (I_2) were relatively less than that of the other groups, presumably due to amelioration in fetal growth imposed by increased metabolism. Group I_2 achieved a smallest value in the number of services per conception followed by groups I_1 and I_0. It seems that positive impact of iodine treatments were shown on reproduction in buffaloes.

In coincidence with these findings, Sushma-Chhabra, *et al.,* (2007) found that iodine supplementation improved oestrus signs, whereas the onset of oestrus in the treatment group ranged from 4-33 days. Also, iodine treatment groups showed a better conception rate compared to the control group. Mavi and Bahga (2005) found that treatment groups improved reproductive efficiency, whereas eight heifers in the treatment group (44%) exhibited oestrus within 60 days of supplementation and four heifers (22%) conceived. In control group, only one heifer (12.5%) exhibited oestrus and none conceived in the same period. Panchal *et al.,* (1991) found that the overall pregnancy rate in the treated animals (42.17%) was significantly higher than that of the untreated controls (17.05%).Bahga and Gangwar (1989) measuring plasma protein–bound iodine in buffaloes after calving during summer and winter seasons and found that values were lower in summer than in winter, and lower in buffaloes requiring less than 30 days for uterine involution than in those requiring more than 30 days: they were lowest in buffaloes requiring more than 50 days for restoration of ovarian follicular development. Bahga (1989) reported that poor reproductive efficiency, postpartum oestrus interval, service period and number of services for conception were observed in animals in the low plasma protein bound iodine group. Gasanov (1991) reported that supplemented buffaloes with injections of tetravitan and supplemented of trivitan, potassium iodide, sodium selenite, calcium triphosphate, proserine, cobalt chloride or zinc sulphate reduced service interval, improved conception to first service.

Sharawy *et al.,* (1987) demonstrated that animals treated with patent thyroid preparation exhibited the highest percentage of heat appearance (86.7%) with 73.3% pregnancy rate, while group treated with supplements of crude iodinated casein revealed that 84.6% came in heat and 69.2% became pregnant and animals treated with potassium iodide revealed that 50% manifested heat while 40 conceived. In sheep, Ferri *et al.,* (2003) reported that 100% of treated ewes mated with treated rams were pregnant vs 37% of the control ewes mated with control rams, also, results demonstrated that iodine supplementation restores fertility of sheep living in iodine deficient areas.

Pregnancy rate:-

Table (9) showed that in control group three buffaloes came in heat after 65 days after delivery, three of them ovulated and conceived. In the second group, fife animals manifested oestrus after 54 days and were ovulated while four of them got pregnant. In the third group all animals exhibited oestrus sings within 45 days, all were ovulated and all will pregnant (100%). Results revealed higher pregnancy rate in I_2 (100%) than in groups I_1 (66.67%) and I_0 (50.0%). This may in relation to level of iodine supplementation, being better with the high (0.5 mg I per kg DM intake /h/d) than low level (0.3 mg I per kg DM intake /h/d) of supplementation. The marked improvement in pregnancy rate of buffaloes supplemented with iodine in I_2 compared with I_0 is in agreement with the findings of Sharawy *et al.* (1987) who found that treatment with potassium iodide revealed that 50% of the treated animals came in heat while 40% got pregnant. Also, Glotra, *et al.,* (1969) found that significant improvement in relation to heat appearance and pregnancy rate in buffaloes supplied by potassium iodide than in control.

Health status of delivered calves:-

As shown in Table (10) the control dams delivered only 4 calves because there was one case of abortion and one case of stillbirth, meanwhile, treated dams delivered 12 healthy calves. The calves from treated dams showed higher body weight, growth rate/day and better vitality in comparison with the control. Likewise, body weight and growth rate/day were higher in newly born calves from I_2 than I_1 and I groups. In addition, no mortality in the 1st month occurred between the newborn calves resulted from iodine treated buffaloes compared to the control group.

Moreover, the control calves showed more severe pneumonia and enteritis as a result of which

2 (33.33%) calves died. The present results support the other views (Mavi *et al.,* 2005) who found that, iodine treatment to late pregnant dams induced better state of reproductive and delivery with no retained placenta or stillbirth in comparison with the control group. The newly born calves were of heavier body weight, better healthy status and highly resistance to disease. The pre and post-partum supplementation with iodine improved the reproductive efficiency of Egyptian buffaloes (Sharawy *et al.,* 1987). Consequently, a high immunoglobulin-G concentration was observed in calves supplemented with iodine. Circulating IgG had been related to pre-weaning growth (Nocek, 1984) as well as long term performance of calves (Wittum, 1995), thus some commercial calf raisers will pay dairy producers a premium for providing calves with serum total protein that exceeds some critical threshold (usually >5.2 to 5.5 g of total protein/dl of serum). Others will reduce the amount they pay to the producer if total protein is too low. Although passive immunity has an important effect on calf health, there are a number of other factors that influence the overall cost of morbidity and mortality on a calf raising operation. These other factors include the level of exposure of calves and level of stress to which calves are exposed. Another critical control point during the calf's life is the first 24 hours. Consumption of colostrum is essential to provide animals with the antibodies and other proteins that calves need to stay healthy. The amount of colostrum (and immunoglobulin, or IgG) consumed determines amount of passive immunity and resistance to disease. When calves consume insufficient amounts of IgG from colostrum within the first 24 hours of life, they are much more susceptible to developing disease and possibly dying. A major reason that pre-weaning mortality is higher than optimum) defined as less than 5% of calves born alive) is due to inadequate IgG intake (Quigley, 2005). Measuring a calf's level of passive immunity within the first week of life allows the producer to know the effectiveness of the colostrum management and calf feeding program . Because this is so important to the health and survival of the calf, it is an essential part of monitoring the overall heifer operation. However, the importance of achieving adequate levels of colostral immunoglobulins to protect the neonate from enteric disease and septicemia has long been recognized) Robinson, 1988).

4. Conclusion

It could be recommended that using iodine supplementation at level (0.5 mg I per kg DM intake /h/d)) in female buffaloes ration tended to improve the digestion, nutritive values, immunity, milk production, milk composition and Reproductive parameters.

Table (1). The chemical composition of feed ingredients and the calculated composition of the Experimental rations.

Items	Chemical composition as DM basis (%)						
	DM	OM	CP	CF	EE	Ash	NFE
Chemical composition of the ingredients :							
CFM*	91.54	92.92	16.79	10.31	4.59	7.08	61.23
BH	90.17	84.31	14.89	24.83	1.78	15.69	42.81
RS	92.91	81.51	3.59	41.80	1.04	18.49	35.08
Calculated chemical composition of tested rations:							
I_0	91.54	88.92	13.77	19.51	3.32	11.08	52.32
I_1	91.49	89.19	14.15	18.68	3.40	10.81	52.96
I_2	91.42	89.57	14.67	17.54	3.52	10.43	53.84

*CFM; concentrate feed mix contained in percentage ; 37% yellow corn , 30% undecortecated cotton seed , 20% wheat bran, 6.5% rice bran, 3% molasses , 2.5% limestone, 1% common salt,.

Table (2). Effect of iodine supplementation on nutrients digestibility and nutritive value of the experimental rations fed to buffalo cows.

Items	60 Days			SEM	180 Days			SEM
	I_0	I_1	I_2		I_0	I_1	I_2	
Digestibility coefficients (%)								
DM	65.42	65.99	66.21	0.32	66.96^c	68.50^b	71.23^a	053
OM	67.12	68.08	68.69	0.39	69.84^b	71.53^{ab}	73.34^a	052
CP	58.08^b	59.22^{ab}	60.08^a	0.33	59.24^c	61.99^b	64.91^a	066
CF	52.31	52.50	53.30	0.27	53.11^b	56.79^a	58.50^a	068

EE	85.66	86.26	86.89	0.34	87.54^{c}	89.82^{b}	92.38^{a}	060
NFE	70.78^{b}	71.61^{ab}	72.74^{a}	0.34	71.58^{c}	75.83^{b}	78.83^{a}	084
				Nutritive value (%)				
TDN	61.63^{b}	62.70^{b}	64.21^{a}	0.41	62.51^{c}	67.08^{b}	69.54^{a}	0.95
DCP	8.00	8.38	8.81	0.20	8.16^{b}	8.77^{ab}	9.52^{a}	0.15

Means bearing different superscripts in the same raw are significantly different ($P < 0.05$).

Table (3). Effect of iodine supplementation on Body weight of buffalo dams during pre- and post- partum and new born calves in the different experimental groups.

Items	I_0	I_1	I_2	SEM
Dam body weight LP (kg)	497	495	496	2.58
Dam body weight PP (kg)	451^{a}	445^{b}	439^{c}	1.90
Calf birth weight (CBW) kg	35.80^{b}	37.00^{b}	41.00^{a}	0.70
Fetal fluid, kg	10.40	10.8	11.00	0.45
CBW / Dam post-partum (%)	7.94^{b}	8.31^{b}	9.34^{a}	0.48
Calf weaning weight (kg)	88.00^{c}	93.40^{b}	99.20^{a}	1.40
Total gain of calve (kg)	52.2^{b}	56.4^{a}	58.2^{a}	0.79
Daily gain of calve (g/day)	0.58^{b}	0.63^{ab}	0.65^{a}	0.07

Means bearing different superscripts in the same raw are significantly different ($P < 0.05$).

Table (4). Immunoglobulin concentration (mg/ml) in colostrums of buffaloes as affected by iodine treatments.

Ig fraction	*Day*	*Treatments*			SEM
		I_0	I_1	I_2	
Ig A	**1st**	3.28^{b}	3.67^{ab}	4.25^{a}	0.14
	2nd	3.19^{b}	3.26^{b}	4.16^{a}	0.19
	3rd	2.65	2.95	3.05	0.24
Ig M	**1st**	4.24	4.71	4.78	0.17
	2nd	3.75^{b}	4.25^{ab}	4.50^{a}	0.19
	3rd	3.36^{b}	3.85^{ab}	4.31^{a}	0.19
Ig G	**1st**	34.53^{c}	42.50^{b}	46.67^{a}	1.03
	2nd	33.98^{b}	35.75^{b}	40.20^{a}	1.02
	3rd	32.81^{b}	34.00^{b}	39.00^{a}	1.05

Means bearing different superscripts in the same raw are significantly different ($P < 0.05$).

Table (5). Effect of Iodine supplementation on milk yield and composition of lactating buffalo cows.

Item	I_0	I_1	I_2	SEM
Actual milk yield, kg / day	8.30^{b}	9.54^{ab}	10.68^{a}	0.40
7% fat correct milk yield (FCM), kg / day	8.00^{b}	9.28^{ab}	11.64^{a}	0.58
Milk composition (%)				
Fat, %	6.64^{b}	6.72^{ab}	7.79^{a}	0.23
Fat yield (kg)	0.55^{b}	0.64^{ab}	0.83^{a}	0.11
Protein, %	4.12^{b}	4.77^{ab}	5.65^{a}	0.24
Protein yield (kg)	0.34^{b}	0.46^{ab}	0.60^{a}	0.09
Lactose, %	3.68^{b}	4.37^{ab}	4.92^{a}	0.22
Lactose yield (kg)	0.31^{b}	0.42^{ab}	0.53^{a}	0.05
Solid non fat (SNF) , %	8.53^{b}	9.82^{ab}	11.14^{a}	0.41
SNF yield (kg)	0.71^{b}	0.94^{ab}	1.19^{a}	0.15
Total solid (T.S) , %	15.17^{b}	16.54^{ab}	18.93^{a}	0.57
T.S yield (kg)	1.26^{b}	1.58^{b}	2.02^{a}	0.23
Ash, %	0.73^{a}	0. 68^{ab}	0.61^{b}	0.02

Milk energy (Kcal / Kg milk)	943[b]	1064[ab]	1188[a]	35.69

Means bearing different superscripts in the same raw are significantly different ($P < 0.05$).

Table (6). Feed intake and Feed efficiency of lactating buffalo cows as affected by the iodine supplementation levels.

Items	I_0	I_1	I_2	SEM
Daily feed DM intake (Kg /h/d) as:				
CFM	6.6	6.6	6.6	-
BH	2.2	2.2	2.2	-
R.S	2.2	1.8	1.3	-
Total DMI	11	10.6	10.1	0.11
Total TDNI	6.88	7.11	7.02	0.07
Total DCPI	0.90	0.93	0.96	0.01
7% fat correct milk yield(FCM), kg / day	8.00[b]	9.28[ab]	11.64[a]	0.58
Feed efficiency:				
Milk yield / DMI	0.75[b]	0.90[ab]	1.06[a]	0.05
7% FCM / kg DM	0.73[b]	0.88[a b]	1.15[a]	0.07
7% FCM / kg TDN	1.16[b]	1.31[ab]	1.66[a]	0.06
7% FCM / kg DCP	8.89[b]	9.98[b]	12.13[a]	0.10

Means bearing different superscripts in the same raw are significantly different ($P < 0.05$).

Table (7). Means concentrations of blood plasma of buffalo cows groups supplemented with dietary iodine.

Items	*LP*			*SEM*	*PP*			*SEM*
	I_0	I_1	I_2		I_0	I_1	I_2	
RBC count x10⁶/mm³	6.45[b]	6.65[b]	7.94[a]	0.08	7.11[c]	7.84[b]	8.81[a]	0.11
WBC count x10³/mm³	5.57[b]	6.11[b]	6.97[a]	0.11	7.44[b]	7.74[a b]	8.22[a]	0.07
Hemoglobin (Hb) g/dl	7.14[c]	7.72[b]	8.97[a]	0.09	7.85[c]	9.58[b]	11.24[a]	0.10
PCV (%)	30.58[c]	33.47[b]	34.42[a]	0.50	31.83[c]	34.33[b]	35.62[a]	0.56
T. protein (g/dl)	6.22[b]	6.89[a]	7.18[a]	0.11	7.14[c]	7.96[b]	8.35[a]	0.13
Albumin (A) (g/dl)	3.06	3.20	3.21	0.02	3.35[b]	3.81[ab]	3.90[a]	0.03
Globulin (G) (g/dl)	3.16[b]	3.69[ab]	3.97[a]	0.03	3.79[b]	4.15[ab]	4.45[a]	0.05
A / G ratio	0.97	0.87	0.81	0.02	0.88	0.92	0.88	0.01

Glucose(mg/dl)	54.95	55.84	56.71	0.27	60.24[c]	65.46[b]	70.12[a]	0.24
BUN (mg/dl)	30.52[c]	36.47[b]	43.98[a]	0.91	36.06[b]	45.10[a]	51.21[a]	0.85
Triglycerides (mg/dl)	21.69[b]	23.47[ab]	24.55[a]	0.31	21.49[c]	25.75[b]	28.52[a]	0.34
Cholesterol (mg/dl)	80.51[a]	79.45[a]	75.11[b]	0.51	87.22[a]	83.54[c]	80.88[b]	0.61
T3 (ng/dl)	98.56[c]	110.45[b]	115.55[a]	2.42	103.25[c]	121.36[b]	130.59[a]	5.22
T4 (ug/dl)	2.14[b]	3.54[a]	3.98[a]	0.22	2.74[c]	4.08[b]	4.97[a]	0.23
P4 (ng/dl)	3.49[a]	3.03[c]	3.32[b]	0.16	1.39[b]	1.70[a]	1.76[a]	0.11
EST 17β (pg/ml)	79.49[c]	105.25[b]	118.58[a]	5.32	36.74[c]	40.79[b]	45.33[a]	1.38

Means bearing different superscripts in the same raw are significantly different ($P < 0.05$).

Table (8). Means of some postpartum reproductive traits of buffaloes as affected by iodine treatments.

Item	**Treatments**			
	I_0	**I_1**	**I_2**	**SEM**
Placental expulsion (hr)	9.83[b]	8.73[b]	6.51[a]	1..2
Uterine involution (days)	52.6[a]	43.1[b]	31.1[c]	9.16
Onset of 1st heat	47.5[b]	54.3[a]	44.7[c]	7.98
No services / conception	2.25	1.71	1.00	0.58
Days open	93.2[a]	86.1[b]	62.2[c]	18.28
Gestation period (days)	325.6	328.6	305.0	
Calving interval (days)	418.8[a]	414.7[a]	367.2[b]	24.07

Means bearing different superscripts in the same raw are significantly different ($P < 0.05$).

Table (9). Effect of iodine administration on the incidence of estrus, ovulation and conception in buffaloes.

Groups	**No. of animals**	**Response of treatment**						
		Days from delivery until appearance of 1st heat	**Heat**		**Ovulation**		**Conception**	
			No.	**%**	**No.**	**%**	**No.**	**%**
I_0	6	65	3	50.0	3	50.0	3	50.0
I_1	6	54	5	83.33	4	66.67	4	66.67
I_2	6	45	6	100.0	6	100.0	6	100.0

Table (10). Mean values of health status of newborns of buffaloes treated with iodine supplementation.

Items	**Health status of delivered calves**		
	I_0	**I_1**	**I_2**
Aborted feti	1	0	0
Still birth	1	0	0
Mortality at 1st month	2/6 (33.33%)	0/6 (0%)	0/6 (0%)
Survival rate	4/6 (66.67%)	6/6 (100%)	6/6 (100%)

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