Feeding and management of calf, a research in the Instituto de Ciencia Animal

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To achieve a productive and stable cattle raising, is necessary good results on calves rearing and their replacement, because the looses during this process, due to the low rates of liveweight gain are not recovered. The secure of the growth and an appropriate development of the calf depends on several factors, which are related with feeding and management. In this review some results of studies carried out on this topic by the researchers from the Instituto de Ciencia Animal from the República de Cuba, published in the Cuban Journal of Agricultural Science during 1970-2014.These studies constitutes an important source of knowledge for the cattle raising development in Cuba and in the tropic. The results of the referred researches can be applied in low inputs systems, common in the humid tropic. The use of dairy foods as colostrum, yogurt, fresh milk and milk replacers in artificial rearing systems and restricted suckling constitutes the main topics. Some results are also commented obtained in the elaboration and use of starter feeds and integral rations, grasses and forages use, and the mineral supplementation to young animals. There are also refers, topics related with the behavior and animal welfare in young calves, as tool to reduce the susceptibility to illness and to improve the productive behavior.

Key words: *calf, feeding, artificial rearing, suckling, behavior and well- being*

INTRODUCTION

The success of any cattle production system depends on the capacity to raise the replacement animals satisfactorily. The rearing period is characterized to be unproductive, since begins with the dry gestating cow and finishes with the first calf heifer. In many occasions, is not paying the appropriate attention to this period, especially to the financial and labor resources. In long term, there will be notice the negative effects on the low efficiency and productivity of the system, poor udder development and low indexes of milk production.

To reach good results in this period, it is essential to guarantee the calf growth, for which is necessary to guarantee the colostrum intake in the moment and appropriate amounts, to have concentrate and voluminous foods, appropriated to their stomach in development, as well as to assure the management and protection adapted to achieve a correct productive performance and to improve the use of the supplyed foods.

The objective of this paper is to inform about the main results obtained in the Instituto de Ciencia Animal, published in the Cuban Journal of Agricultural Science, with the purpose of stimulating the development of calf feeding system, as sustenance of a highly productive and efficient herd.

ATTENTION TO GESTATING COW, THE COLOSTRUM, THEIR USE AND CONSERVATION

During the last gestation month, the cow shows a negative energy balance, due to the increment of the demand of calf nutrients, to the increase of nutrients movements for colostrum synthesis and to the reduction of DM ingestion capacity, which restricts the ingestion of necessary nutrients for this period. This situation can extend until the second postcalving week and, although cows have the possibility to move reserve, its excess could cause pathological and reproductive problems (Ybalmea 2011a).

Researchers carried out by García and González (2003) showed the importance of the gestating cow feeding level in the pre-calving period. The calves, cows sons with low feed level in the pre- calving period, were weaker at born, and more susceptible to respiratory and diarrhea diseases. This is related with the amount of the colostrum immunoglobulins (Ig) and their magnitude of intestinal absorption.

To reduce the lethal effects of the dam nutrition in calf health and vitality and in dams reproductive indicators, the supply of 1 or 3 $kg.cow^{-1}d^{-1}$ in the last gestation third was recommended (Reyes *et al.* 1998),which guarantee higher accumulation and availability of body reserves. From these results, LWG of 500 $g.cow^{-1}d^{-1}$ was suggested in this period, approximately, to maintain productive levels of 20L. $cow^{-1}d^{-1}$ and to rearing a calf with adapted liveweight and vitality. Pérez (2012) results support these ideas, because as the calves were weightier, higher LWG is obtained during their lactation period.

USE OF FRESH AND CONSERVED COLOSTRUM

The colostrum is the ideal food for the newborn calf; it contains the appropriate nutrients quantities for their first days of life. Their immunoglobulins (Ig) contribution, which passes untouched through the openings of the calf intestine membrane, is essential. The good quality colostrum contains 50g of Ig. L^{-1}, that provide to the newborn the enough passive immunity (10 mg.mL^{-1} of whey) and high viability.

Although the supply of 4L. d^{-1} is common, divided into two times, during the first 12h after birth, the supply of different amount of colostrum and its response on calves health and growth was evaluated. Plaza *et al.* (2009a) recommended the use of five liters with the same frequency and the use of the whole colostrum that were produce in the farm, which permits to reduce mortality at only 1,38%. However, with the use of 6 or 7 Ld^{-1}LWG higher to 500 g/calf/$d^{-1}$are achieved (Santos *et al.* 1984).These results showed that is advisable the use of the colostrum that is produce in the dairy for calf feeding, because it is an important nutrients source (proteins, fats, vitamins and minerals) that assure, better results than marketable milk.

Each cow of medium potential (8 L.d^{-1}) can produce 30L of colostrum as average. To use all that is produce, it is necessary their conservation. Although several methods exits, the one that supplyed best result was the propionic acid to 1% (V/V),that produced food with better organoleptic characteristics and stability, and it was the one that calves intake and caused less looses in the conservation process(Vera 1988).

CALVES REARING IN SUCKLING SYSTEMS

In Ugarte and Preston (1973) studies, the well management restricted suckling system showed increase of 30% in the total milk production, as well as higher LWG, due to the residual milk use, of high content in fat and total solids(Ugarte 1977).This aspect, joined to mastitis reduction incidence, have been two fundamental elements of the restricted suckling systems development. In other Ugarte and Preston (1975a) researches, the restricted suckling reduced in 12% the clinic mastitis incidence, mainly in the first ten weeks after calving. The calf presence and the efficient extraction of the residual milk seem to have beneficial effect in this sense. To suckle can be so effective, that six days after causing in experimental way the udder infection with *Stafilococos aureus* ($1x10^9$ bacteria.mL^{-1}), it disappeared from the initial infection (Rigby *et al.* 1976). However, it is necessary to control the time calf is feeding, since to calf is more time with the cow the parasitism increase (Ugarte *et al.* 1974a),due to it is exposed to infection sources(faeces and grazing).It also influences the poor paddock rotation to break the life cycle of internal parasites.

The control of calves LW is indicator of milk consumption and allows establishing a balance between the milk for sale and the one calf intake. With this objective, several experiments were carried out and it was showed the cows of higher propitiations of *Bos indicus* genes produces more milk, which allows dedicating higher volume for sale and for calf intake, with higher LWG (Ugarte and Preston 1972a).Also, was proven that to suckle during 15 min., after each milking, it was enough to assure intakes of 5.2 L. $calf^{-1}$ and sales of 6.5 L.$cow^{-1}d^{-1}$ in average potential cows(Veitía and Simón 1972). Just happened the opposite when suckling began two hours after milking, because the marketable milk production decreased and the milk intake by the calf increased (Ugarte and Preston 1972b).

The possibility of eliminate the suckling since the first month of age, when the cow reached the productive peak was evaluated (Ugarte and Preston 1973). However, the prospective results were not reached, because milk intake was decreased, from 6.83 to 2.56 L. $calf^{-1}$ and calves were not able to recover in later periods, in spite of the increase of the starter feed intake, which increase the system costs (Ugarte 1976b).The increase of suckling, over of 56 d of age, reduced milk production in the suckling without it behaved to the LWG increase, possibly due to the low concentrates intake by the extension of the lactation period, that promotes lower ruminal development (Ugarte 1976a and Ugarte *et al.* 1974).

In one of Ugarte (1978) paper was showed that LWG of calves rearing in restricted suckling with suckling at 70d was similar to calves in artificial rearing, with suckling at 35d of age and both were higher to the suckling with nurse cows. It was specify that the system with the last ones requires a management and knowledge of nurse cows production to assure the amount of milk to the calves that feeds.

In spite of the restricted suckling benefits, this could affect the herd reproductive indicators, when increasing the time mothers are with the calves. Due to hypothalamic stimulation increasing, the β-endorphin and the realising gonadotrophins hormones (RGnH) production is reduced, which results in an ovarian activity with reproductive cycles less stable. An increase in the calving-first insemination interval and the service period in the traditional suckling system was showed, although there were not variations in the restricted suckling system (Lima *et al.* 2009).

However, when comparing restricted suckling systems and artificial rearing, a decline of reproductive indicators in cows in restricted suckling is show, with effects on the total of maketable milk, in sales and the herd economy (Pérez 2012),.

Use of fresh milk . Due to the availability of resources for cattle, during several years fresh milk was used in calves feeding. Several systems and supply forms were studied, and with the differed supplys system the best results were obtained, 6 L.d^{-1}, until 30 d of age and 3 L.d^{-1}, from 31 d up to weaning (Plaza *et al.* 1986) or four liters in similar period (Zarragoitía *et al.* 1989).

The results of this feeding system are supported in the increase of milk intake in the first month of age, critical moment for the calf because of their susceptibility to illness, food dependence and low starter feed intake. When reducing milk intake from 30d of age, a stimulus to concentrate foods intake is produce, necessary to accelerate the rumen development and to allow the suckling in better physiologic condition and less stressful.

Use of yogurt. Although there were not differences in the blood indicators of calves feed with different yogurt levels (Chongo *et al.* 1988), the use of 240L, differed supplyed(6 L from 11 to 30 d and 4 from 31 to 60 d) allowed to obtain better results, with higher gains to 600 g. calf^{-1} (Castillero 1988 and Plaza *et al.* 1988).

In a general way, the use of yogurt supplys similar results to those of the fresh milk, and reduces the digestive disorders. Even, the supply of 200, 240, 280 and 320 L of yogurt to weaning ages of 50, 60, 70 and 80 d, respectively, did not cause differences between treatments, due to the dairy feed differed dupply and the starter feed intake in the weaning earliest ages(Plaza and Fernández 1991 and Plaza and Fernández 1999a).

Although the calves eat little concentrate food during the first month of age, they show avidity for the dairy feeds intake. This circumstance was use by Plaza and Fernández (1999b) to save approximately 80Lof yogurt. calf^{-1}, with use of 14 kg of concentrate food, distributed between the 21 and 60 d of age. This method allowed using the yogurt as medium of concentrated food that pass directly to the abomasums, reticular carcass way, and let from the ruminal fermentation. These foods are digested efficiently by the digestive intestinal enzymes, without increasing the digestive diarrheas incidence.

Development and use of milk replacer for calves. In spite of the good obtained results with the use of fresh milk or yogurt, the price of the powdered milk in the international market was increased with the time and the use of dairy feeds to feeding calves became expensive. Also, the milk demand to cover human consumption necessities increase, for which the milk replacers development was an strategic task for the institution and the country.

Initially the use of cane molasses as candidate for their incorporation in the milk replacers was evaluated. However, their use was not recommended, due to the poor digestive use and to the diarrheas increase, as the supply to the calves increased (Chongo and Thivend 1982). Other carbohydrates, as glucose and fructose, showed higher levels of intestinal absorption, without affecting calves health.

There were also carried out a group of researches to evaluate others available foods in Cuba to elaborate milk replacers.It was possible to substitute until 38% of dairy protein by (*Candida utilis*) torula yeast (Chongo and Suau 1983), but same as non dairy feeds, the intestinal passing of non protein nitrogen was higher with higher levels to 25%, without affecting the milk replacer intake neither other physiological indicators in study.

The use of 20% of torula yeast produced similar nutrients digestibility and the first milk replacer was prepared, named "Setolac-20" that also contained, 50% of skim milk in powder and 20% of bovine tallow, and allow obtaining gains between 500 and 550 g. calf^{-1} (Gonzalez *et al.* 1993). Also, the physical-chemical characteristics of the food reconstitute in water and the increase of fat levels of the product. This food could not widely use, due to their powdered milk composition, 50% of DM. However, the researches carried out allows to identify the torula yeast as a feasible food to be used in suckling calves feeding and establish the points for further studies, related with the inclusion dose.

Due to technological limitations for milk replacers elaboration, in that moment the use of torula yeast, added to the calf fresh milk was evaluated (Gonzalez 1990), and it was showed that it is possible to substitute two liters of fresh milk by 200g of torula yeast, after 21d of age, without affecting the calf performance, but there was protein excess in the diet. This was applied in thousands of calves, in commercial farms, during several years, with excellent results.

Based on these studies, a milk replacer was evaluated, that contained whey, torula yeast, raw sugar and milled maize (Plaza and Fernández 1994), supplyed in quantities of 720 g or 1440 g. calf^{-1}, starting from 31 d of age. This food had similar result regarding the fresh milk and LWG higher than 600 g.d^{-1}, without diarrhea affectations. This showed the possibilities of formulating milk replacers without dairy feeds, and opened a perspective for the use of these foods in the country.

Plaza and Hernández (1996a) worked in the torula yeast until levels of 57 %, 10 % of raw sugar (Plaza and Hernández 1996b), and 5 % of bovine tallow (Plaza and Hernández 1996c) and sweet potato meal (*Hipomea batatas*), in substitution of maize meal (Plaza and Fernández 1997).The possibility of obtaining LWG higher than 560 g.d^{-1} was showed and the sugar sweet flavor was identified, as an stimulant to these foods intake, with low levels of dairy feeds. This is the way

in which the milk replacer "RELAC" is suggested, as trade mark by the Instituto de Ciencia Animal.

In this period a pea protein concentrate was produced (*Pisum sativum*) for their inclusion in the milk replacers dedicated to calves, due to its good amino acids composition .It was also recommended for human consumption (Madrigal *et al.*1992).The obtaining and use of this type foods, as protein concentrates, proteins and hydrolyzed starches, among other, will be a topic to be in further studies, since it will allow to produce appropriates milk replacers, since the first week of age.

The results obtained with "RELAC" fallow the supply of appropriate milk quantities in the first month of age, that assure appropriate LWG for this period and the use nondairy feeds, when the calf shows higher readiness of digestive enzymes for their use. Equally, lactose it is included, as milk or whey, which stimulates the food intake by the calf and the use of starter integral ratio, appropriated for the intake and early rumen development.

From these results, a feeding system with non dairy milk replacers was designed, in which were supplyed from 4 to 5L of milk. $calf^{-1}$, during the first 20d of age, 4L plus 100g of milk replacer, from 21 to 30 d, and 1L of milk plus 500g of replacer, to 31d old up to the weaning calves (90 d).Besides supplying starter integral rations and water *ad libitum* during the whole period. This technology was applied in 106. 000 calves, in commercial farms, and allowed to obtain LWG above 450 $g.d^{-1}$, without damage of the calves health (Ybalmea 2011).

With the inclusion of 20% of fat added whey in RELAC composition (Ybalmea *et al.* 2004), it was possible to increase the milk substitution potential and to eliminate the liter of fresh milk that was still used after 30d of age, to correct fat dispersion in the product, to reduce the particle size and to improve their solubility in water. Also, it allowed the product industrialization, in conditions of low resources and equipping. With this food 70 % of the milk that the calf intake was substitute and 250Lof milk for human consumption was release, per each reared calf.

Based on results that showed the high digestive use of the soya bean protein concentrate by the calf and due to the increase of turula yeast cost, this one was satisfactory substitute by the soya bean protein concentrate, and a good digestibility dairy replacer was obtained, with LWG higher to 550 $g.d^{-1}$, without differences regarding the powdered milk use (Ybalmea 2011).

Another research showed that it is not possible to use imported milk replacers, with low diary feeds levels, before the first month of age (Barbosa 2010).This, join to similar results, obtained by Ybalmea (2011), referred to milk replacers of national production, made necessary to carry the milk to the rearing units for calves intake in the first 30d of age. However, when a milk replacerof higher quality was evaluated (Plaza and Ybalmea 2008), the whole milk the calf intake was substitute, and it was release for human consumption, approximately, 360Lof milk per reared calf, with lower costs to 50% regarding milk use.

All these researches favored a group of dairy replacers that constitute an option for calf feeding in the tropic, and can be formulated in commercial farms, to low cost than the commercials and with lower dependence of the international market, These contributions showed the way to further studies, from new available foods in the producers and processors food industries.

EARLY WEANING OF CALVES WITH MILK AND CONCENTRATES FOODS

With the application of the early weaning, milk intake decreases and the possibilities that the early rumen development supplys for the efficient transformation of foods are used, once the weaning is carried out. Quiñones and Preston (1968) proved that is possible to obtain LWH higher to 530 $g.d^{-1}$when applying the early weaning, between 35 and 42 d of age, in Holstein calves, with initial liveweight between 36 and 37 kg and milk intake between 96 and 120 L. However, at present, the average weight of newborn calves is approximately 32kg (Pérez 2012), which decreases the ingestion capacity of starter feed, and moderate LWG are obtained. This limits the application of early weaning, because it could delay the calves development.

Nevertheless, researchers to study new formulations of high quality starter foods are designed, in those the appropriate balance of the digestible nutrients in rumen and intestine be stated, that increase the digestibility and nutrients intake, main early weaning limitation under current conditions of commercial cattle.

STARTER FEEDS FOR CALVES. USE OF INTEGRAL RATIONS

The use of starter feeds for young suckling calves is important for the obtaining of satisfactory results. This food, joined to other liquids (milk, yogurt and dairy replacers) and voluminous (hay, forages, grasses), provides the necessary nutrients for the calves growth. It was showed that the appropriate dairy foods supply during the first month of age and starter feeds use up to intake 2.4 kg. $calf^{-1}$ is enough to feed calves under tropic and Cuba conditions (Plaza *et al.* 1988).

Cereals use. Cereals are the main energy component of calves starter feeds. Due to wheat availability, they

were evaluated as maize replacement. It was proven that it is possible to use until 40% of wheat, in combination with 20% of maize (Marrero *et al.* 1986), without affecting the ruminal pH and food intake. Although with the use of 9% of bentonite, pH regulator product (Marrero *et al.* 1987) or 20% of milled hay as integral ration (Plaza *et al.* 1993), it was possible to incorporate up to 60% of milled wheat. The hay, grossly milled, reduced the carbohydrates digestion speed of the wheat grain, the bypass and stability of the ruminal pH, and it was obtained as a result higher LWG and reduction of diarrhea effect.

An available food in the tropic, and of excellent use by the ruminants, is the dehydrated citrus pulp (*Citrus sinensis*).This one is produce when dehydrating the wastes of citrus juice production. It was proven that it is possible to include in the starter feeds, 46% of dehydrated citrus pulp, in substitution of 100% of maize (Santos and Aguilera 1981) and 70.5% in sorghum substitution (Michelena *et al.* 1983).The ruminal fermentation indicators, intake, food conversion, nitrogen retention and diarrhea incidences were similar to the cereals use.

The fermentation pattern of the dehydrated citrus pulp is similar to that of the grains and shows low abrasive ruminal action. The inclusion of higher levels of this food without fibrous foods causes severe ruminal parakeratosis. It was showed that, in these cases, the use of forage can solve the problem, although the LWG can be lower when these constitute the base diet (Rodríguez *et al.* 1974).

Use of hays and forages meals. Although the forages can constitute an alternative for calf feeding, the contradiction between their higher volume and the poor ingestion capacity exits, regarding the nutrients demand of high digestibility of the young calf. To solve these problems, integral rations are designed, formulated with the voluminous food inclusion, cuts or grossly milled, joined to the rest of the starter feed components. This way, the protein concentrates and energies with voluminous foods coexist, that supply the necessary nutrients for the calf, and contributes to the ruminals papilla development, necessaries to assure motility, muscular development and the reduction of ruminal metabolic illnesses incidence, as the parakeratosis and hyperkeratosis.

In the integral rations many foods can be used, Bacvanski *et al.* (1975) used the sunflower seed hull, and the best LWG (802 g. $calf^{-1}$) were reached, with CF values of 5.6%, higher to those reached in the diets with 0 and 10% of inclusion. These authors showed the necessary balance that should exist between concentrates and fibrous foods in the integral rations.

The use of 15% milled hay of Coast cross Bermuda grass (*Cynodon dactylon*) mixed with the starter feed, as meal or pellet, allowed to improve the intake and alimentary conversion indicators and rumial development (papillas.cm^2) and to reduce the ruminal metabolic illnesses (Plaza *et al.* 1983 and Plaza *et al.* 1984).However, when integral rations are supplyed, the hay milled levels can run to 20%,(Plaza *et al.* 1990), and to 30% if are pelleted. Although Plaza *et al.* (1985) recommended the use of integral rations with milled hay levels up to 40%, without LWG decline and reduction in cost of calf feeding (Plaza *et al.* 2011).

The supply of growing levels of fibrous food, according to the calf age, is a way of reducing the effects that make decrease the intake and the LWG. It was showed that the use of integral rations with 20% of milled hay until 90 d and 30 %, from 91 to 180 d, was better regarding to the long hay and to the concentrate foods, *ad libitum* and separate(Plaza *et al.* 2009 b).

Based on the same feeding system, with the use of integral rations diets for calf young bulls were evaluated (Plaza *et al.* 1989).It was recommended to use 660L of differed milk, up to 120d of age and integral rations with relation concentrate: forage of 80:20, until intake of 4.08 $kg.calf^{-1}$, and eight months of age. Regarding the moment in which the research was carried out, the LW costs increase were acceptable. Nevertheless, at present, the intake of similar volume of milk is only justified for this purpose.

From the possibility of incorporating of non conventional foods in the starter feeds elaboration, Ybalmea *et al.* (1995) formulated a feed based on leaves meal, cassava tubers(*Manihot sculenta*) and wastes of cabbage crop(*Brassica oleracea capitata*). In spite of the low milk intake, these authors obtained LWG of 472 $g.d^{-1}$.Also, integral rations with the inclusion of 28 % Califa leaves meal(*Acalipha hispida*) and 15% of cassava leaves meal(*Manihot sculenta*) were prepared, and satisfactory results were also obtained(Ybalmea and García López 1998). Martínez (2009) added until 30% of 50:50 mixtures of milled hay and tithonia foliage meal (*Tithonia diversifolia*), in substitution on behalf of the maize and soybean cake, with gains higher to 750 g. $calf^{-1}$.

These researches allowed knowing the potentialities of the milled fibrous foods in integral rations mainly in the tropical area, where there are a wide availability of tree species of higher nutritive value, which can be use in substitution of the import concentrates foods and of high cost, which makes feasible this technology for low inputs systems. The study of new integral rations formulation, formulated for different purposes and categories correctly, constitutes a topic of great importance to develop in later periods. Mainly is of interest for those formulations that accompany the milk replacers with low quantity of dairy foods, formulated in Cuba, that allow the application of the early weaning in calves of size and liveweight available in the country.

*Use of sugar cane products on the young calves Rations***.** Sacharina, obtained food by biotechnological ways from sugar cane (Elías *et al.* 1990), it was satisfactorily used in integral rations destined to calves. T his product allowed substituting until 33% of cereals (Marrero *et al.* 1992a) and it was included in 35% of the integral ratio (Marrero *et al.* 1992b).The use of higher proportions (Marrero *et al.* 1993) produced lower slaughter weight of the empty body and the empty reticulum-rumen of the experimental period, which was associated to the higher fibrous content of the ratio, lower energy level and increase of the fibrous ballast of the diets high in fiber.

The use of 30% of milled cane bagasse in integral rations favored the NDF and ADF increase, until 25.53 and 21.58 %, respectively. This promoted more rumination time, less rest and lower LWG, which is related with the fiber excess in diet (Ybalmea *et al.* 2008).These results showed that, although the use of fibrous foods is a necessity in calves diets, it is not convenient that present higher fiber content. Similar results were obtained with the use of integral rations and similar sacharina levels (Marrero *et al.* 1993).

Nevertheless to the obtained results with Sacharina, the use of dry and milled cane (Solicaña) in calves integral rations between 90 and 210 d of age was evaluated (González *et al.* 1992).It was proven that to use up to 30% supplyed good results and reduce the diets cost, when substituting a part of cereals. Even in calves early fattening, when using 25% of this food in animals of 91 to 180 d, and 50 % from 181 to 360 d (Plaza *et al.* 2000a) allowed LWG higher to 1 kg.animal^{-1} d^{-1} as average until the year of age. In these researches carcass and eatable meat of 56 and 40 % were obtained, respectively. Also, was proven that calves slaughter should be between 270 and 360 d of age, to improve carcass indicators (Plaza *et al.* 2000b).

The use of homemade protein molasses, obtained food by anaerobic fermentation of cane molasses, in 50:50 proportion(V/V) with final molasses, showed to be a viable alternative regarding the use of molasses-urea system at 3%, in calf weaned with 120 d of age. This technology also includes, forage, 460g of sunflower meal and minerals salts *ad libitum* (Plaza *et al.* 1999a).

USE OF GRASSES AND FORAGES IN CALVES FEEDING

Grasses are the food of lower cost for the stockman. However, approximately 90% of calves parasitic infestation is produce in grazing. The tropic guarantees high temperatures, relative humidity and rapid grass growing, which provides ideal conditions for its proliferation. When being conjugated these conditions with the incorrect application of grazing rotation, low nutritional quality and calves tolerance to parasitism, as well as the stress for movement excess and extreme temperatures, lead to lower LWG rates and calves death.

When evaluating the enter age to the grass (5 or 42 d), Ugarte *et al.* (1975) verified that there were not differences in calves performance, possibly, because both groups were still young for grazing. This was proven in Saavedra *et al.* (1980) researches, whose achieved better LWG when calves grazing pangola(*Digitaria decumbens* Stent) at 60 or 90 d of age, regarding to the access at 30d.

Also, pangola grazing, in weaned calves of 90d of age, caused low LWG (277 g.d^{-1}), still with the supply of 400 g. calf^{-1} of a supplement 56.2% of CP and 2.13 MJ of ME of DM^{-1}.Although there was not mortality in grazing period, the results are related with the grass low quality, with maximum of 4.2% of CP and minimum of 53% of CF. Undoubtedly, grasses of this quality, cannot maintain the intake of necessary nutrients for calves in growing(Veitía *et al.* 1975).

From these results, it was concluded that it was necessary to supplemented the young calves in grazing during the first months of life, due to the grass limited intake and their low quality, mainly when it is not appropriately managed and became old (Benítez 1980). The evaluation of fertilization effect was an option to increase the grass quality. It was proven that to apply 100 or 200 kg de N.ha^{-1}year^{-1}to the Coast cross Bermuda grass (*Cynodon dactylon* vc. Coast Cross 1) the CP of 8 to 11 % increase, improved the digestibility in 6%, the ME in 0.22 Mcal.kg MS^{-1} and consequently the estimated LWG (Valdés *et al.* 1982).

In another research 300 kg N.ha.year^{-1} was applied and similar values of CP and DM digestibility were obtained. With grasses of this quality, there were not differences in feeds use with CP levels of 8.81 to 21.25 % in calves between 70 and 196 d of age (Gonzalez *et al.* 1990), but the level of digestible protein in the intestine(DPI) for the obtained gains it is also guaranteed. However, the ratio energy contribution should be had present, because the use of the fish bypass protein and the higher ruminal solubility of grass protein, can caused, in this case, imbalance in protein relation: energy and lower gains to the potential. The use of the concentrate with 8.81% of CP, formulated with cereals, molasses and a vitamin- mineral complement, and only 2% of fish meal, was enough to reach LWG higher to550 g. female calf^{-1}.

However, Geerken *et al.* (1980a) checked that to

supply 400 g.d^{-1} of a supplement of 60:40 % of PN: NPN to calves that intake Coast cross Bermuda grass forage with 8.31% of CP, improved the total DM intake, forage DM and DM digestibility. In a similar way happened with N and energy (Geerken *et al.* 1980b), since the N retention of 32.9 % to 49.2 % was increased, due to supplementation. Everything is due to the primary action of the energetic-protein supplementation in the ruminal microbial synthesis.

In another research the importance of supplemented concentrates foods to calves that only intake forages and milk was confirmed (Plaza and Hernández 1994). Both food groups are not complemented each other: forages passes to the rumen and milk goes directly to the abomasum, through the reticular canal. This study has practical importance, because many producers use only milk and grasses as food for young calves. When falling in the rumen fibrous low quality foods, a not very efficient fermentation takes place. The cellulolysis and ruminal passage decreases, and low levels of VFA propionic and butyric are produced, the development of ruminals papillas is also slower. On the other hand, the concentrate presence in the rumen, joined to grasses, improves the ruminal fermentation parameters and with it, the cellulolysis, ruminal passage, forage intake, VFA production and papillary development.

A research to evaluate the cut age effect on the intake and grasses digestibility, fertilized and irrigated in dry season (400 kg de N.ha^{-1}year^{-1} and 500 m3 every 15 d) was carried out, regarding the pangola use, with any cut age, applied between 30 and 60 d of regrowth, in stabulated calves of 120 kg LW (Ruiz and Cairo 1991).It was determined that cut age affected the forages intake, which assure the importance of grass quality in young ruminants. Also, Geerken *et al.* (1977) showed that, in rainy as in dry season; bermuda intake was higher, due to the higher DM digestibility, ME and N, and higher N content. The N retention with Bermuda was also higher. The estimated LWG were of 800 and 400 g.d^{-1} for both grass species, respectively.

It was showed that in calves between three and five months of age, in pangola grass, it is possible to substitute up to 100% of hay by grasses silage, although the LWG did not passed the 300 g.d^{-1} and the DM intake (330 g.d^{-1}) with silage, regarding to 1.1kg of hay DM. However, in calves with more than five months, the LWG were near to the 500 g.d^{-1}, with 100% of substitution. These show the possibility of their use in calves of this age. Nevertheless, it is necessary to increase nutrients content and the silage digestibility to improve the results and to support the supplementation with 1.2kg of concentrate food per animal (Santos *et al.* 1980).However, the pangola grass restricted grazing was better (2 h.d^{-1}), instead of 1kg of hay as base diet, for supplemented with molasses- urea at 2% to calves of similar age (Ugarte and Preston 1974).

The protein banks are an economic variant for young calves feeding. Similar results were reached with the use of 270kg of concentrate food or only 150kg, more 12 h of Coast cross Bermuda grass grazing, and 4h in glycine (*Neonotonia wightii*) protein banks. The use of protein bank allowed saving 120kg of concentrate foods per female calf, without differences in the retained energy and higher efficiency of ME use for fattening, at five or 12 months (Marrero *et al.* 1989).

When supplementing molasses – urea at 2% to six months of age female calf there were not found benefits (Ugarte and Preston 1975b).The LWG and conversions obtaining with molasses as supplement to the grass, suggest that there is not advantage for their use and if there is grass availability, since it acts as grass substitute food and can reduce ruminal cellulolysis by the easy fermentation carbohydrates.

Nevertheless, the obtained results in the last years in calves feeding in grazing with supplementation, their stabulation until six months of age has been recommended, with integral ratio use, in order to reduce the stressful effect that young calves grazing in the humid tropical area means. If there are not good quality hays or integral rations, the use of good quality forages (grass, legumes or a mixture of them), fresh and milled is recommended, plus the supplementation with concentrate foods, until reaching 2.5 kg. calf^{-1} intakes (Plaza and Ybalmea 2004).

Besides the weaning, the use of diets with levels of 50:50 of concentrate and forage did not affected calves performance, regarding higher levels of concentrate foods (Plaza *et al.* 1999b).These results were use as base to create feeding systems with integral rations for female calf meat production (Plaza *et al.* 2000b).

MINERAL SUPPLEMENTATION AND UREA USE IN YOUNG CALVES

The calcium and phosphorous supplementation as dicalcium phosphate was studied. The interest of supplemented between 5 and 3.5 g.d^{-1} and 8 and 5 g.d^{-1} for both minerals, respectively, to calves of 75kg LW was proven, feed with Coast cross bermuda grass forage as base food. The supplementation allowed increasing the digestibility and Ca and P retention, although this indicator varies according with these minerals concentration in the used fodder sources (Gutiérrez *et al.* 1984).The natural superphosphate as national alternative to the imported dicalcium phosphate was evaluated. In spite of the flour content, retentions of both minerals higher to 80% were achieved and the use of this minerals natural source was recommended, whenever

the consumption of 40 p.p.m of flour is not exceeded (Gutiérrez *et al.* 1983).

Another research with the objective of evaluating the modified zeolite (their surface electric conductivity and their hydrophobic properties was transformed) in the reduction of harmful effects of the zearalenona was carried out. However, was only produced ruminal pH increase, but it detoxifying effect was not proven (Nešic *et al.* 2010).

Also, it was possible to reduce diarrheas incidence and to increase the accumulated LWG at 90d of age in fed calves with yogurt, supplemented with 20 $g.d^{-1}$of dry peat and finely milled (Plaza *et al.* 1999c). Apparently, the combined effects on the yogurt diarrheas reduction, joined to antiseptic and anti- inflammatory qualities of the peat made possible these results.

From studies carried out by González and Elías (1984), the use of urea in feeds for young calves was not recommended, although after the third month of age the results were satisfactory. It is admitted that the use not only depends on the calves age but, of the availability of easy fermentation carbohydrates, that allow the assimilation of ammoniac levels that take place in the rumen by the urea hydrolysis.

STUDY OF THE BEHAVIOR AND ANIMAL WELFARE, IN CALVES REARING

For the development of these researches, some indicators that allow knowing the influence of management and housing in the behavior, and animal productivity were kept in mind. The behavior is the external manifestation of animal life basic necessity. The alimentary behavior is the expression of two essential requirements: hunger and thirst (Álvarez *et al.* 2004).The voluntary ingestion of foods is the most important factor in the manifestation of the productive potential of all animal species, and it constitutes the main limitation of production in the tropic, when depending of several factors each other related, all in function of satisfying the nutritious necessities of the animal.

It was showed that the crosses female calf 5/8 Holstein - 3/8 Zebu, between one and four months, develop their ingestion capacity mainly during the day, related with the hours of food supply (Quincosa *et al.* 2005). These studies allowed establishing a relation between the increase of intake time as the ingestion capacity is increased and grass quality worsens. These results confirm the necessity to supply good quality forages and concentrated foods for the young ruminant.

The use of individual metallic nest was recommended, only in the first month of age, when calves are more susceptible to illnesses, and it was insisted in that is essential the veterinarian individual control. Also the assimilation of concentrates foods intake would be easier. However, as they grow, experiment on stress, which is stated with the appearance of oral stereotypes not related with the ingestion (Ybalmea *et al.* 2007), due to contact limitations with other animals, vital space reduction, absence of contacts with the mother and other from their own specie, as well as the lack of free life.

In the calves housed on the floor, in groups, the stereotypies were not verified. However, in this case the problems are not related with the mutual suction increase of different parts of the body, which make easier illnesses infection, the stress by the reduction of the resting time and the increase of time they remain on foot, because the floor humid, after the cleaning with water. The floor humid also increases the breathing illnesses.

To reduce the floor humid effect, in combination with low temperatures and high relative humid, and it effect on breathing affection increase, the use of hay beds for calves housing in groups was recommended, mainly in winter season. The calves that use the beds experienced less stress, when dedicating more time to resting and foods intake, with LWG of 509 $g.d^{-1}$, regarding the 440 $g.d^{-1}$obtained in calves without bed (Ybalmea and Benítez 2011).

FINAL CONSIDERATIONS

The compiled information in this review shows the work of years of study, which allowed solving practical aspects related with calf rearing under Cuban tropic conditions.

Important results hat showed the supplementation level and the gestating cow gains were obtained, as preamble of a healthy and vigorous calf born, the production of colostrums of quality and a more productive lactation safety. Other researches allowed to confirm the necessity and opportunity of using all the colostrums producing in dairy units, for their Ig contribution and nutrients highly assimilable for the calf.

The development of researches in suckling systems allowed knowing their potentiality, if the pair cow- calf is appropriately managed, in such a way that decreases to the minimum its contact, since this can affected the reproductive indicators that reduce the herd productivity.

The researches to make more efficient the use of dairy foods (milk, yogurt and milk replacers) showed the benefit of differed systems, six liters up to 30d and three or four until the weaning. These guarantees higher LWG in this period and weanings less stressful. The

researches for the evaluation of new replacers allowed having a group of these foods more cheaply than their similar imported and than the fresh milk, which allow to substitute more than the 70 % of the milk that calf intake, for human consumption. To continue researches in this topic is fundamental, because we did not had yet the milk replacers elaborated in Cuba, that allow to substitute all the milk the calf intake. It is important to continue studies in searching the possibilities of new foods, feasible to include in the mentioned milk replacers.

An intensive activity was developed in the grasses and forage study in calf feeding. Although the results show the possibility to herd calves during the first month of age, was showed that as the age of get into the grass increased, the animal is favored. The stabualtion until six months of age is recommended. It also knew the importance of grasses and forage supplementation, mainly those without irrigation and fertilization, due to their low CP content and higher fiber values.

The use of integral rations appears as a useful option, because its advantages in calf feeding, appropriate for low inputs conditions, since it allows including agro industrial products and by products, as well as protein forages meal, among other available foods in the tropic. The creation of new formulations, adapted to each stage of the calf growth and productive purpose, should be assisted in the future.

Others topics as the use of probiotics and prebiotics and others, will have to be included in further studies, because it is known that can be represented important contributions to the nutrition and calves health under tropic conditions.

Although the animal welfare topic has been not very mention in our researches, studies about stress effect and welfare in animal productivity should carried out. Cuba is not out of world globalization, which it is necessary to fulfill certain rules and standards for animal production. That is why, the application of studies results about the animal welfare it is totally necessary and to deal this topic from the tropic conditions and the climatic change that is strong and it places more and more in foods production.

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Received: October 30, 2014