

Head-start strategies for optimal calf rearing

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Optimal calf rearing in accordance with the ForFarmers calf rearing concept has the objective to yield a full grown heifer that is ready to calf at an age of 22-24 months with a robust frame and a maximised intake capacity for a high life performance.

The first few months are critical for a successful head start which will have a big impact on future development and uniformity in the rearing stock.

Performance in the first lactation period is important but even to a greater degree is an animal that will perform well in subsequent lactation cycles, thus reducing costs of herd replacement.

This article will focus on general nutritional guidelines for optimal calf rearing and the opportunities for the use of modern strategies of performance enhancers based on additives that are currently being developed for zootechnical additives in line with European Directive 1831/2003.

Optimal colostrum supply

Successful calf rearing practices start with an optimal supply of colostrum for building immunity during the first three days of life.

The first 24 hours represent the most critical period, as disease resistance is provided by the presence of immunoglobulins in the first milk of the dam and the ability of the calf to absorb these antibodies into its immature system.

After the first 24 hours there is a decline in the efficiency of colostrum in regard to blood IgG levels, so the objective should be to feed 5-6 litres of colostrum per day during the first three days. Making maximum use of the first, high quality, colostrum will give an extra boost to the immunity during the first months of life.

After colostrum feeding the calves

Age (days)	Amount	Water	Concentrates	Roughage
1-3	Colostrum			
4-7	2 x 1.5 - 1.75 l	Limited, 2 l/d (35°C)	Coarse grain mix, Ad libitum	Grass/Alfalfa hay
7-14	2 x 2.0 l	Ad Libitum	Calf starter, Ad libitum	Grass/Alfalfa hay
14-28	2 x 2.5 l	Ad Libitum	Calf starter, Ad libitum	Grass/Alfalfa hay
28-42	2 x 3.0 l	Ad Libitum	Calf starter, Ad libitum	Grass/Alfalfa hay
42-49	2 x 2.5 l	Ad Libitum	Calf starter, Ad libitum	Grass/Alfalfa hay, Maize silage
49-56	1 x 4.0 l	Ad Libitum	Calf starter, Ad libitum	Grass/Alfalfa hay, Maize silage
56-63	1 x 2.0 l	Ad Libitum	Calf starter, Ad libitum	Grass/Alfalfa hay, Maize silage
63-84		Ad Libitum	Calf starter, Ad libitum	Grass/Alfalfa hay, Maize silage

Table 1. Feeding schedule in addition to milk replacer (Source: ForFarmers BV).

are normally switched to a milk replacer. The feeding schedule is shown in Table 1, which is part of the ForFarmers calf rearing concept. In this context, 125g of milk replacer is supplied per litre of milk.

The milk replacer specifications should follow a protein content of 19-21% and a fat content of 15-17%, depending on the rearing condition on the farm. It should not contain any skimmed milk powder but be based on high quality dairy products.

Thereafter, calves fed a milk replacer without skimmed milk powder will start earlier on solid feed which will support rumen development and progressively limit milk feeding without the growth depression commonly seen at weaning. At the age of eight weeks the switch is made to once-a-day feeding to provide a smooth transition to weaning and improve appetite for concentrates and roughage

Early intake of water

To get to the objective of a functional rumen, early intake of concentrates and roughage water supply at an early age is essential.

Fresh drinking water should be supplied starting at day four of life (Table 1) and to supply it at 30-35°C for the first week to improve its acceptance by the animal. The advice is to limit water availability during the first two weeks to two litres a day.

In the ForFarmers concept, the start is made with a coarse grain mix with includes a pelleted concentrate with added vitamins and minerals

with the aim to ensure an early adaptation to the intake of solid feed next to the daily amount of milk replacer. The mix is sprayed with molasses to improve flavour. After adapting to solid feed, calves will be switched to a pelleted calf starter in week two.

Next to the calf starter, the young calves need a coarse source of fibre for optimal rumen function and development. Chopped grass hay or alfalfa hay are the preferred sources for young calves (Table 1).

After five weeks the diet can include high quality maize silage that has a dry matter content of over 34% to insure sufficient dry matter intake. Feeding equipment has to be kept clean at all times to ensure sufficient intakes of the different feed components including the water supply.

Hygiene during rearing is a principal point to sustain animal health and prevent digestive problems during calf rearing.

To ensure weaning without loss of growth the advice is to start lowering the amount of milk replacer when concentrate intake exceeds

1.0kg/head/day. Calves are ready for weaning if intake of concentrates exceeds 1.5kg/head/day, this concentrate intake is necessary to ensure sufficient daily growth after weaning. In Table 3 a few indicators are given to insure optimal calf rearing according to the ForFarmers calf rearing concept.

The role of plant extracts

While sound nutrition in calf diet formulations form the basis for a successful programme, research over the years has shown that certain additives have been able to give a valuable boost to optimise calf rearing even further.

One such example are plant extracts and their active substances which have been shown to enhance feed efficiency, animal performance and well being during calf rearing.

But while plant extracts have been used over the years as solutions to many problems in livestock production, only recently has light been shed on critical aspects relating to their stability and safety.

Only by mastering the stability, traceability and release of these substances in the animal will certain commercial products show consistent efficacy and be truly sustainable alternatives under EU Directive 1831/2003.

Stability starts from within, and university based findings have already led to a better understanding of the variability in response to many Origanum based commercial products, based on its active ingredi-

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Table 2. Indicators calf rearing over 84 days (Source: ForFarmers BV).

Intake	Amount per calf (kg)
Milk replacer	30-35
Calf starter	110-125
Days	Growth (g/day)
0-63	>750
0-84	>900

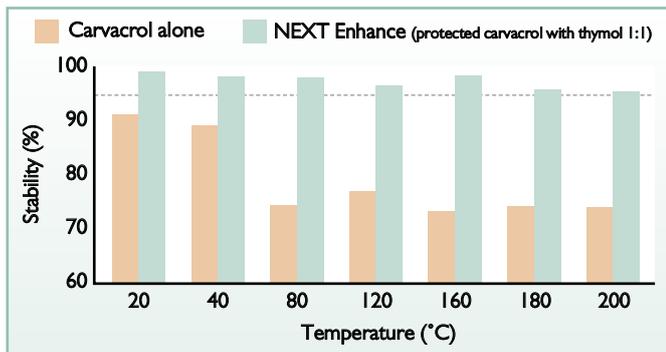


Fig. 1. Stability of carvacrol alone (major ingredient of *Origanum spp.*) versus the protected combination 1:1 thymol and carvacrol. Dotted line indicates no absolute loss of active ingredients (Source: Carotenoid Technologies SA).

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 enters thymol and carvacrol. When included in certain vitamin mineral premixes that undergo pelleting or expanding processes, the stability of these molecules has been called into question, as earmarked by significant losses or transformations to other distinct molecules (Fig. 1).

The partnering of molecules as well as protection systems as those defined below, offer solid technical alternatives to conventional systems which simply absorb plant extracts on a dry carrier.

Microencapsulation

Protective encapsulation systems have also been found to provide additional benefits. Studies up to now show that the success of protection of non-nutritive additives, such as plant extracts and their active ingredients, depend largely on relating the type of encapsulation protection with the active material to be coated, and the objectives and species targeted.

Even though the concepts of microencapsulation and controlled release are relatively old, attention to these concepts with respect to plant extracts has only been recent.

The patent pending protection system of a combination of 1:1 thymol and carvacrol developed in Tarragona, Spain benefits the physical stability and delivery of the active ingredients it encapsulates. This method includes a two-step encapsulation process which is unique in two ways. First, it enables active material to be concentrated by up to 57% in a single particle. Second, it allows for the full encapsulation of particles by a special layer of mono and di-glycerides ensuring all active components are retained below the surface. They can improve the physical characteristics of a dry product, especially with respect to handling and behaviour in modern feed production, and they provide a differential release of active substances in the animal.

Proper encapsulation correctly can have immense benefits on the physi-

cal aspects of microadditives evaluation in today's feed formulations.

There is no place in feed production for products which tend to be dusty, electrostatic, or hydroscopic. The benefit of a protected capsule not only eliminates problems of dispersibility and homogeneity of these micro-additives, but also provides a

Table 3. Effects of a control calf starter diet versus a control calf starter diet supplemented with NE 150 (encapsulated 1:1 thymol and carvacrol) on live weight, daily weight gain, dry matter intake, feed conversion ratio and diarrhoea score in starter calves (Source: Carotenoid Technologies SA).

	Control starter diet	Control starter diet plus NE 150*	SEM
Live weight (kg)			
6 weeks	59.63	59.05	2.82
12 weeks	93.59	96.88	3.45
20 weeks	147.17 ^b	155.92 ^c	4.85
Average weight gain (kg/day)			
6-12 weeks	0.81	0.90	0.05
13-20 weeks	1.09 ^b	1.20 ^a	0.06
6-20 weeks	0.96 ^b	1.06 ^a	0.03
Dry matter intake (kg)			
6-12 weeks	2.04	2.11	0.07
13-20 weeks	3.64	3.78	0.10
6-20 weeks	2.90	3.01	0.06
Feed conversion ratio			
6-12 weeks	2.52	2.34	0.15
13-20 weeks	3.34 ^b	3.15 ^a	0.25
6-20 weeks	3.02 ^b	2.84 ^a	0.31
Diarrhoea score¹			
6-20 weeks	3.84 ^b	1.62 ^a	0.45

*NE 150 = encapsulated 1:1 thymol and carvacrol. ^{a,b}Means with different letters are significantly different. ¹Diarrhoea score: 1 = normal, 2 = foamy, 3 = mucousy, 4 = sticky, 5 = hard

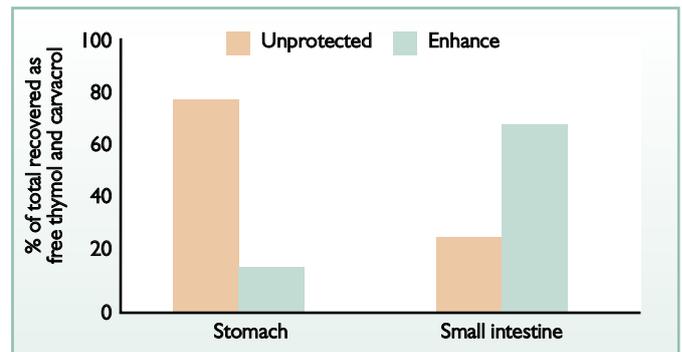


Fig. 2. Altering the release kinetics of the active ingredients to the lower gut by System Enhance (encapsulated combination 1:1 thymol and carvacrol) (Source: Carotenoid Technologies SA).

physical barrier against the reaction of the active ingredients with other micro-nutrients such as vitamins and minerals.

Microencapsulation also reduces the risk of irritation from concentrated phytochemicals to handlers. Previous cutaneous irritation studies on the skin of rabbits conducted by Phycher Bio-

Development in France in 2006 compared a non-encapsulated combination of 1:1 thymol and carvacrol versus the encapsulated form (System Enhance) 150 shown the unprotected product was classified with a primary cutaneous skin irritation score (IPc) of three indicating a R38 risk and classified as irritating to the skin.

However, with the System Enhance protection, the primary cutaneous skin irritation score was reduced to a value of one, indicating no risk of irritation.

Preliminary trials have also confirmed benefits of the System Enhance using flow through dissolution cell models simulating the gastric and small intestine characteristics of the young animal.

The System Enhance was shown to alter the release kinetics of a 1:1 stable combination of thymol and carvacrol versus the unprotected combination (Fig. 2). The System Enhance significantly released more of the active ingredients to the small intestine, indicating that this unique patent-pending protection system also affects targeting of active ingredients, releasing them where the animal really needs.

Animal studies have also shown the benefits of an encapsulated form of a 1:1 combination of thymol and carvacrol. One such study performed in a European private farm with calves fed an encapsulated 1:1 combination of thymol and carvacrol (NE 150) showed benefits in increased liveweight and reduced feed conversion ratio and diarrhoea score (Table 3). These results confirmed that added value technologies such as the System Enhance yielded additional benefits on top of an optimal calf starter with relation to performance and well being benefits during the delicate post-weaning period.

Field trials in several European countries continue to stream in showing that research driven feed additive strategies based on solid science can yield sustainable feed additives for the future which give a boost to optimal calf rearing programmes such as the ForFarmers calf rearing concept. ■