

BIOSIS SPECIAL

Improving Feed Efficiency with Capsicum

The current events (geopolitical issues, rising inflation around the world, higher freight costs, etc) have a direct impact on the availability and price of raw materials, such as corn and soybean meal. In the event of rising raw materials costs, one direct way to better utilize feed is to improve the feed efficiency, often measured as the Feed Conversion Ratio (FCR = quantity of feed necessary to obtain a unit of animal product (meat, egg or milk)). This would be achieved with the help of the right feed supplements. For a few years, *Capsicum* derivatives have been identified in the literature as a promising candidate to increase or maintain animal performance in stressful situations such as heat stress [1,2]. One of the documented effects of capsaicinoids, a family of secondary metabolites responsible for the pungent aspect of chili, is their ability to activate the TRPV1 receptors (transient receptors potential vanilloid 1 – Figure 1). Those receptors are widely expressed throughout the whole animal bodies [3]. This activation of the TRPV1 signaling pathway leads to several benefits such as an ability to increase the excretion of digestive enzymes, for example lipases and proteases (Table 1), as well as increased saliva and bile acids

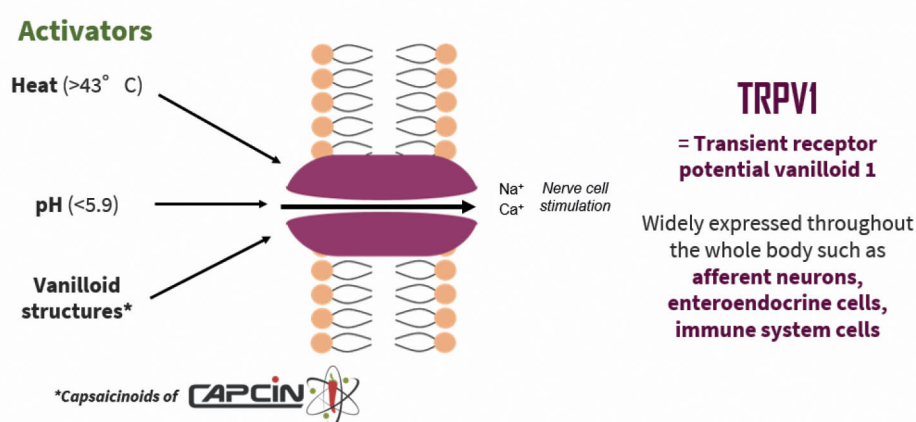


Figure 1: Capsaicinoids are able to activate the TRPV1 pathway. Source: ID4FEED

production. Additionally, capsaicinoids could also enhance the immune function of the gut, which could promote the villus height in the ileum and thus increase nutrient absorption and digestibility [4, 5].

For a few years, ID4FEED, together with its partners around the world, has conducted their own research on the ability of the commercial product ID PHYT CAPCIN to increase animal performance and, in particular, feed efficiency. This unique product consists of a non-extracted chili pepper totum, standardized in capsaicinoids (min. 0.5%) and encapsulated into a fatty matrix.

Table 1: Effects of Capsicum on pancreatic digestive enzyme activities in weaned pigs on d28 (U/mg). CON = control (basal diet). CTC = Control + 75mg/kg chlortetracycline. NCE = Control + 80mg/kg Capsicum extract with 2% capsaicinoids. Source: [4].

Item	CON	CTC	NCE	SEM	P-value
Pancreas					
α-amylase	20.71	16.13	15.93	2.12	0.20
Trypsin	43.97	41.75	47.16	4.04	0.57
Chymotrypsin	4.45	4.60	6.12	0.62	0.15
Pancrelipase	151.72 ^b	180.51 ^b	250.79 ^a	12.34	<0.01
Jejunal mucosa					
α-amylase	66.24 ^b	88.14 ^b	337.25 ^a	25.90	<0.01
Trypsin	13.01 ^b	16.09 ^b	16.89 ^a	0.76	0.02
Chymotrypsin	5.56 ^b	6.59 ^b	7.19 ^a	0.22	<0.01
Ileal mucosa					
α-amylase	43.18	38.66	34.65	6.10	0.64
Lipase	13.82 ^b	17.59 ^a	18.50 ^a	0.86	0.02
Entero-proteinase	5.95 ^b	6.62 ^{ab}	7.32 ^a	0.28	0.04

NCE = natural capsicum extract; CON = control; CTC = chlortetracycline; SEM = standard error of the mean.

World of botanicals

Capsicum replacing chlortetracycline in weaned pigs

The study investigates the effects of supplementing weaned pigs with Natural Capsicum Extract (NCE with 2% capsaicin at 80mg/kg) replacing chlortetracycline (CTC at 75mg/kg). NCE replacing CTC could enhance performance by improving total tract digestibility, digestive enzyme activities (eg pancrelipase activity in pancreas, lipase activities in the jejunal mucosa and in the ileal mucosa on d28, p<0.05). NCE also improved antioxidant capacity, anti-inflammatory function and gut volatile fatty acid composition.

Long et al., Animal Nutrition (2021). [8]

Capsicum as growth promoter in broilers

This experiment studies the effects of a Capsicum Extract (CAP with 2% capsaicin) at 100, 200, and 300 mg/kg of feed on Arbor Acre male broilers. 100 and 200 mg/kg CAP supplementation decreased the FCR between d 1 and 42 (control = 1.57 vs 1.50 and 1.49 respectively, p<0.05), enhanced digestive enzyme activities (eg lipase activity of jejunal contents at 21d). 200 mg/kg CAP also improved the jejunal development, and increased the relative liver and Bursa of Fabricius weight (p<0.05).

Li et al., Frontiers in Veterinary Science (2022). [7]

Improved FCR in poultry (broilers)

Literature

Several publications demonstrated the interest to use *Capsicum* derivatives to improve the performance of broiler chickens [2, 5, 6, 7].

ID4FEED research

A trial in 2017 was conducted in Arbor Acres Plus broilers in metabolic cages in order to study if part of the energy of diets can be replaced by ID PHYT CAPCIN. The study was done between 14 and 17 days of age and three diets were compared: a positive control (PC) using palm oil as a fat source, a negative control (NC) with -1% palm oil replaced by fine sand and a negative control + ID PHYT CAPCIN at 200g/t (NC+CAP). Dietary Apparent Metabolizable Energy (AME) and Nitrogen corrected AME (AMEn) of the NC were significantly lower as compared to the PC diet (Table 2). NC + CAP significantly improved protein of the NC diet to the level of the PC diet. The same trend was observed for protein retention.

Further zootechnical trials between 2017 and 2020 in different countries demonstrated the benefit of using ID PHYT CAPCIN in broiler at a dosage between 100g/t and 200g/t to improve the FCR by -0.03 in average. The average Return On Investment (ROI) is 3:1.

Improved FCR in swine (growing-finishing pigs)

Literature

A recent article presented the interest to supplement weaned piglets with *Capsicum* product [8].

ID4FEED research

In a first trial organized in 2020 in Kaestart University (Thailand) on Duroc * Large White * Landrace pigs with 6 replicated of 3 pigs each, FCR was improved by -0.12 compared to the control (FCR = 2.42) and the supplemented group (FCR=2.30) between 11 and 20.5 weeks of age. Further field trials done in Spain (2021) and South Africa (2022 – Table 3) demonstrated a decreased FCR of -0.10 and -0.15 respectively, with an average (ROI) of 7:1.

Better feed efficiency in ruminants (dairy cows and lambs)

Literature

It has been demonstrated that *Capsicum* supplementation in dairy cows could linearly increase feed efficiency according to the dosage [9].

ID4FEED research

In a trial done in Brazil in 2020 on 14 Holstein dairy cows supplemented with 800mg/cow/day of ID PHYT CAPCIN during 20 days, the feed efficiency (milk yield / Dry matter intake) of the supplemented group was significantly increased compared to the control (1.28 for the supplemented group vs 1.20 for the control). The average ROI in dairy cows is 27:1 (average of 3 trials).

In another trial conducted in Brazil in Lacaune lambs, the FCR was significantly improved with higher dosages of ID PHYT CAPCIN in the feed and the ROI comprised between 12:1 and 4.5:1.

References

- [1] IRTA, EFSA Supporting Publications (2015).
- [2] Munglani *et al.*, Livestock Research International (2019).
- [3] Fernandes *et al.*, British Journal of Pharmacology (2012).
- [4] Long *et al.*, Animal Nutrition (2021).
- [5] Liu *et al.*, Poultry Science (2021).
- [6] El-Hack *et al.*, Poultry Science (2022).
- [7] Li *et al.*, Frontiers in Veterinary Science (2022).
- [8] Long *et al.*, Animal Nutrition (2021).
- [9] Oh *et al.*, Journal of Dairy Science (2017).

Table 2: Effects of replacement of 1% palm oil by ID PHYT CAPCIN on dietary AME

AME = [(Gross Energy feed * g feed consumed) – (Gross Energy excreta * g excreta)]/g feed consumed.
Source: ID4FEED

Treatment		AME as fed (kcal/kg)	AME as dry (kcal/kg)	AMEn as fed (kcal/kg)	AMEn as dry (kcal/kg)
Group	Diet				
1	PC	2939 ^a	3311 ^a	2736 ^a	3082 ^a
2	NC	2886 ^b	3257 ^b	2683 ^b	3028 ^b
3	NC+CAP	2948 ^a	3325 ^a	2746 ^a	3097 ^a
P-Value		0.0047	0.0063	0.0036	0.0049
Pooled SEM		10.762	12.097	10.537	11.911
CV, %		0.90	0.90	0.95	0.95

Table 3: Results of a field trial conducted in South Africa in 2022 on PIC pigs from 72 to 150 days

Source: ID4FEED

	Control = 5800 Pigs (9 Previous batches)	Supplemented group with ID PHYT CAPCIN 100g/t, 1200 pigs (2 batches)
Final body weight (kg)	101	101
Overall ADG (g/d)	913	973
Feed intake (kg/pig/day)	2.24	2.24
Overall FCR (kg/kg)	2.42	2.27
Carcass weight (kg)	76.8	77.1

Conclusion

The *Capsicum*-based product ID PHYT CAPCIN could be used to improve feed efficiency in several animal species, which can be especially interesting in a context of high raw material prices or in stressful conditions such as heat stress or calving. Based on those results, ID4FEED developed matrix values in broilers, growing-finishing pigs and ruminants (dairy and beef) for formulators who wish to decrease the cost of supplementation. Those matrices can be provided by ID4FEED team upon request.

Other applications of the product are possible, such as the supplementation in sows (before and after farrowing) which improves the performance and health of piglets at weaning.



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