

Fine characterization of a standardized citrus extract and its effect on weaned piglet performances.

Dr Sekhou CISSE, Product R&D manager
Session 63 - Monoguthealth - Part 2



Introduction

Lot of interest in Citrus based products in Animal nutrition

Poultry

> *J Anim Sci*. 2023 Jan 3;101:skad069. doi: 10.1093/jas/skad069.

Fine characterization and microbiota assessment as keys to understanding the positive effect of standardized natural citrus extract on broiler chickens

Sekhou Cisse ^{1 2 3}, Muriel Bahut ⁴, Coralie Marais ⁴, Olivier Zemb ⁵, Pierre Chicoteau ^{2 3}, Mohammed El Amine Benarbia ^{2 3}, David Guilet ^{1 3}

> *Br Poult Sci*. 2003 Dec;44(5):810-1. doi: 10.1080/00071660410001666943.

Effect of a citrus extract (NOR-SPICE AB) on broiler performances

H Juin ¹, T Elgaard, P Chicoteau

> *J Sci Food Agric*. 2020 Nov;100(14):5126-5135. doi: 10.1002/jsfa.10525. Epub 2020 Aug 6.

Dietary supplementation with citrus extract alters the plasma parameters, circulating amino acid profiles and gene expression of small intestinal nutrient transporters in Chinese yellow-feathered broilers

Miao Yu ¹, Zhenming Li ¹, Gang Wang ¹, Yiyang Cui ¹, Ting Rong ¹, Zhimei Tian ¹, Zhichang Liu ¹, Jiazhou Li ¹, Weidong Chen ¹, Xianyong Ma ¹

Swine

> *Animals (Basel)*. 2020 Jan 10;10(1):112. doi: 10.3390/ani10010112.

Citrus Extract Improves the Absorption and Utilization of Nitrogen and Gut Health of Piglets

Yiyang Cui ^{1 2 3 4 5}, Zhimei Tian ^{1 2 3 4 5}, Gang Wang ^{1 2 3 4 5}, Xianyong Ma ^{1 2 3 4 5}, Weidong Chen ^{1 2 3 4 5}

> *J Anim Physiol Anim Nutr (Berl)*. 2022 Jul;106(4):813-824. doi: 10.1111/jpn.13623. Epub 2021 Aug 26.

Effects of dietary citrus extract on growth performance, carcass characteristics and meat quality of pigs

Yi-Yan Cui ¹, Zhi-Mei Tian ¹, Dun Deng ¹, Zhi-Chang Liu ¹, Gang Wang ¹, Wei-Dong Chen ¹, Xian-Yong Ma ^{1 2}

> *Transl Anim Sci*. 2020 May 14;4(2):txaa059. doi: 10.1093/tas/txaa059. eCollection 2020 Apr.

Standardized Natural Citrus Extract dietary supplementation influences sows' microbiota, welfare, and preweaning piglets' performances in commercial rearing conditions

Sekhou Cisse ^{1 2}, Mohammed El Amine Benarbia ^{1 2}, Anne Burel ¹, Marie Friedrich ¹, Beatrice Gabinaud ³, Éric Belz ⁴, David Guilet ², Pierre Chicoteau ^{1 2}, Olivier Zemb ³

Aquaculture

Aquaculture Research

REVIEW ARTICLE | [Full Access](#)

The beneficial effects of citrus peel waste and its extract on fish performance and health status: A review

Osman Sabri Kesbiç, Ümit Acar, Eman Y. Mohammady, Shimaa M. R. Salem, Janice A. Ragaza, Ehab El-Haroun, Mohamed S. Hassaan ✉

Shabana et al. *The Journal of Basic and Applied Zoology* (2019) 80:51
<https://doi.org/10.1186/s41936-019-0119-x>

The Journal of Basic and Applied Zoology

RESEARCH

Open Access

Effect of dietary *Citrus sinensis* peel extract on growth performance, digestive enzyme activity, muscle biochemical composition, and metabolic enzyme status of the freshwater fish, *Catla catla*

M. S. Shabana, M. Karthika and V. Ramasubramanian*



Introduction



But not all citrus base product are the same !

Nature of the products



Citrus pulp



Citrus zest

Technological processing

Inclusion rate



g/T of feed
Growth performances enhancer



Kg/T of feed
Raw material substitution

Lack of standardization of the citrus based product used



Variability in the observed effect



Importance to improve knowledge regarding Citrus based product composition

Standardized Natural Citrus extract (SNCE)



1 - Characterization

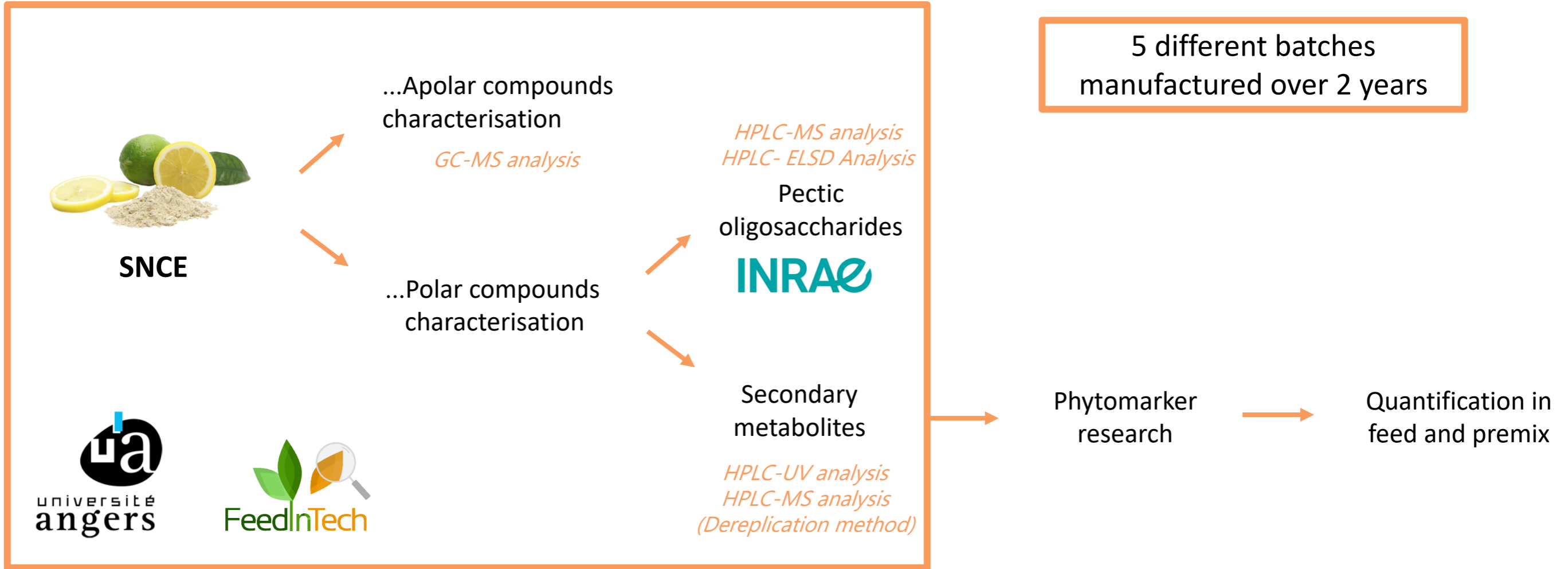
2 – Evaluation of SNCE dietary supplementation effect on weaned piglets' growth performances



MATERIAL AND METHODS

Material and methods

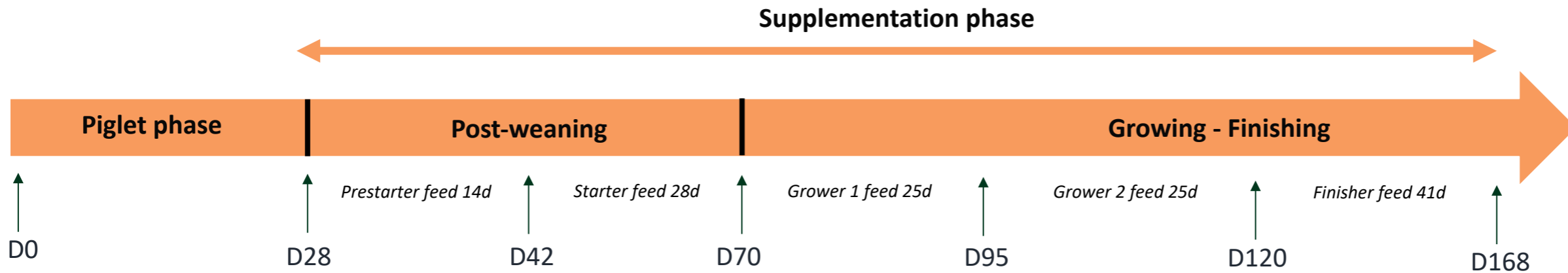
1 - SNCE Characterization





2 – Evaluation of SNCE dietary supplementation effect on weaned piglets' growth performances

Trial protocol



Two treatments :

CTL group: Standard diet without supplementation

SNCE group: Standard diet + 250 ppm of SNCE from D28 to D168

12 replicates of 36 piglets per group

Wheat based diets without antibiotics, organic acids, enzymes, and probiotics.

Observed parameters

Growth performances :
(ADFI, ADG, FCR)

Mortality



Duroc x Landrace x Large white

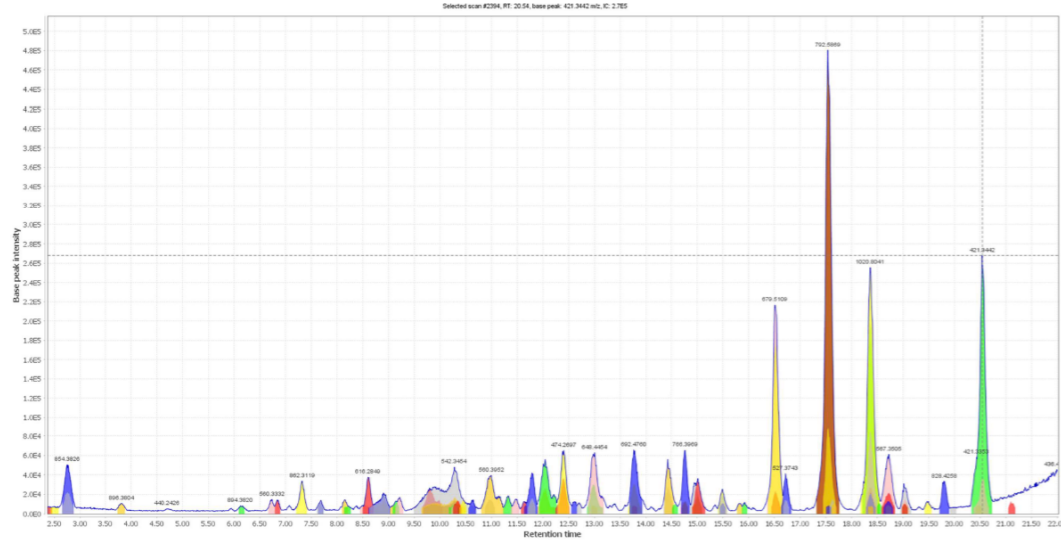


Results



Results

1 - SNCE Characterization

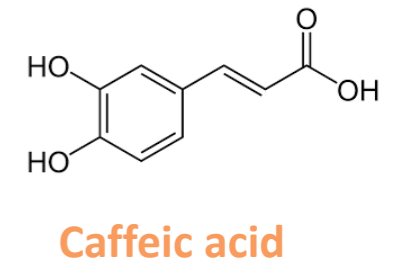
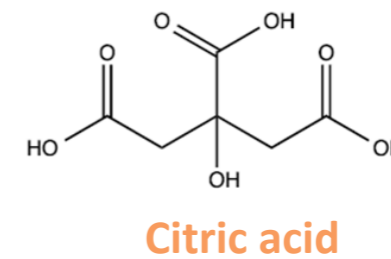
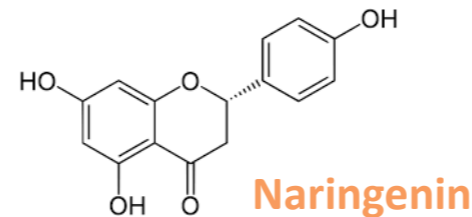
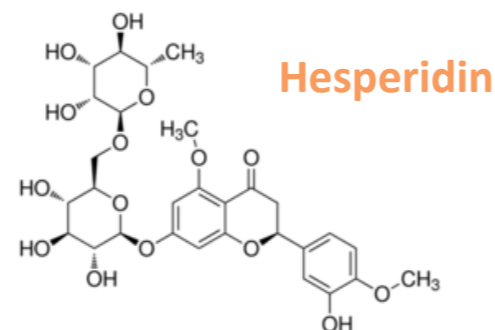
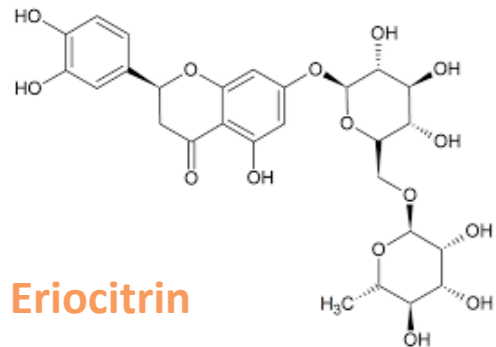


SNCE Mass Spectrometry Profile after SPE purification

Few apolar compounds in the SNCE

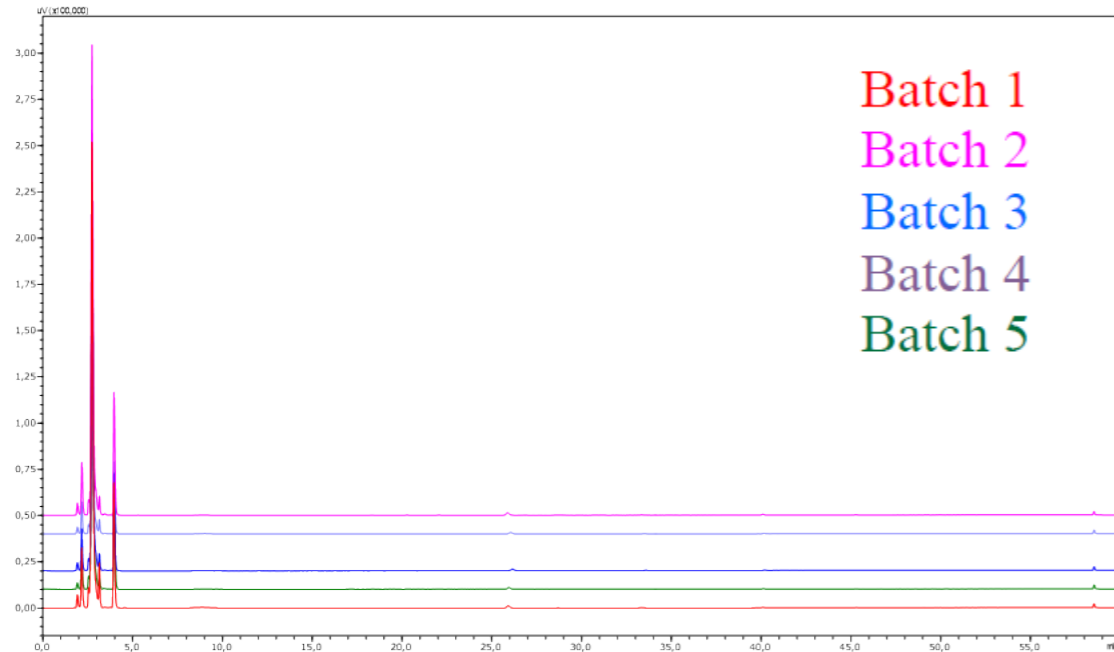
106 Pectic oligosaccharides identified and classified according to their molecular weight

More than 30 secondary metabolites in the SNCE

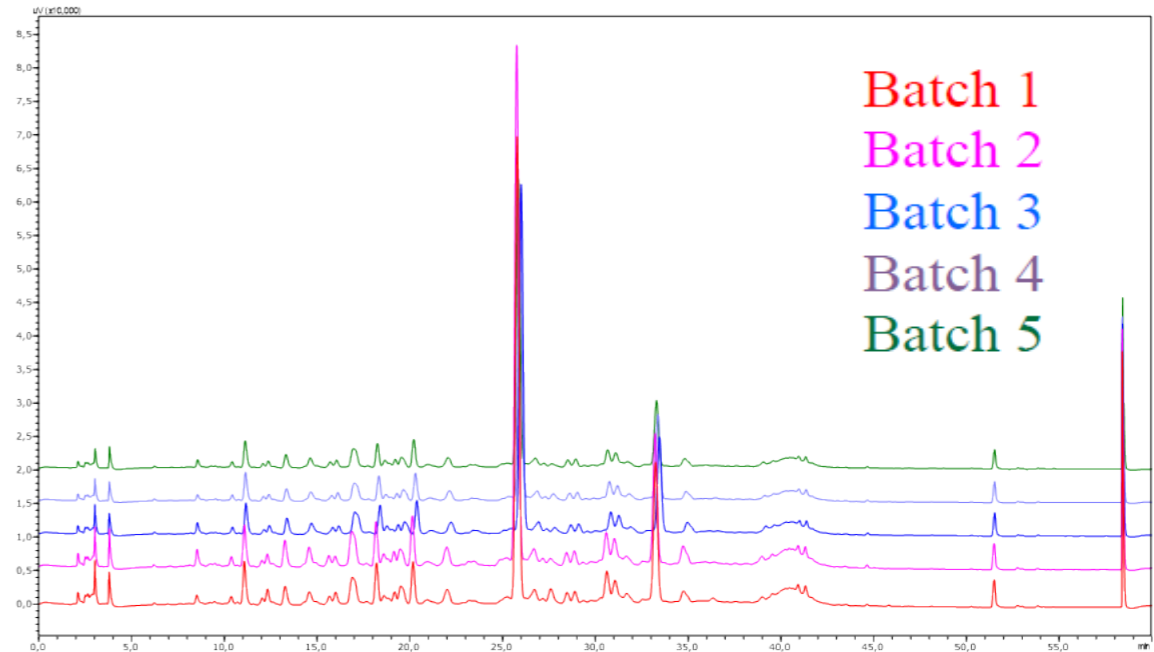


Results

1 - SNCE Characterization



ELSD profile of 5 different SNCE batches manufactured over 2 years



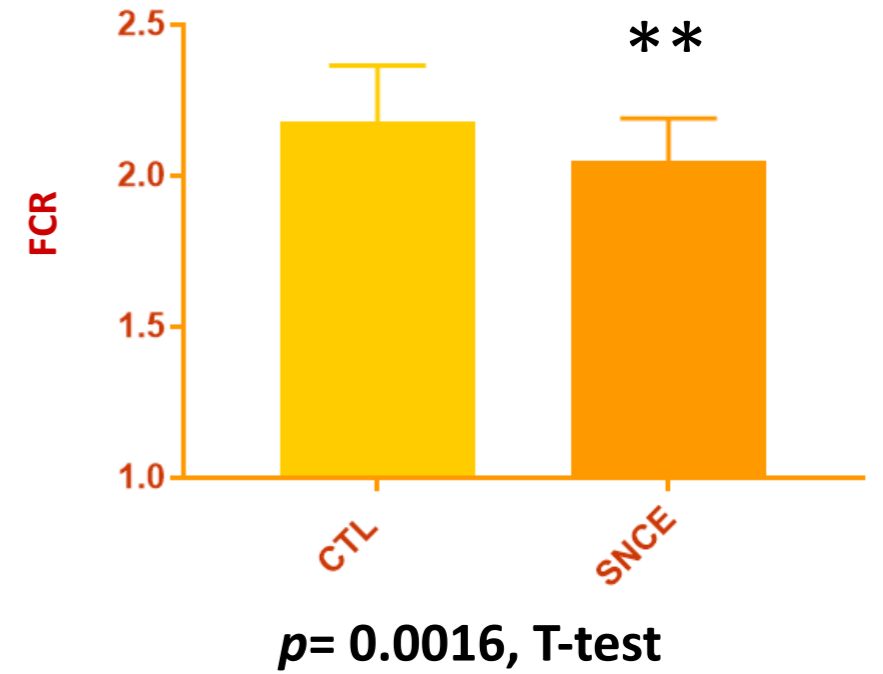
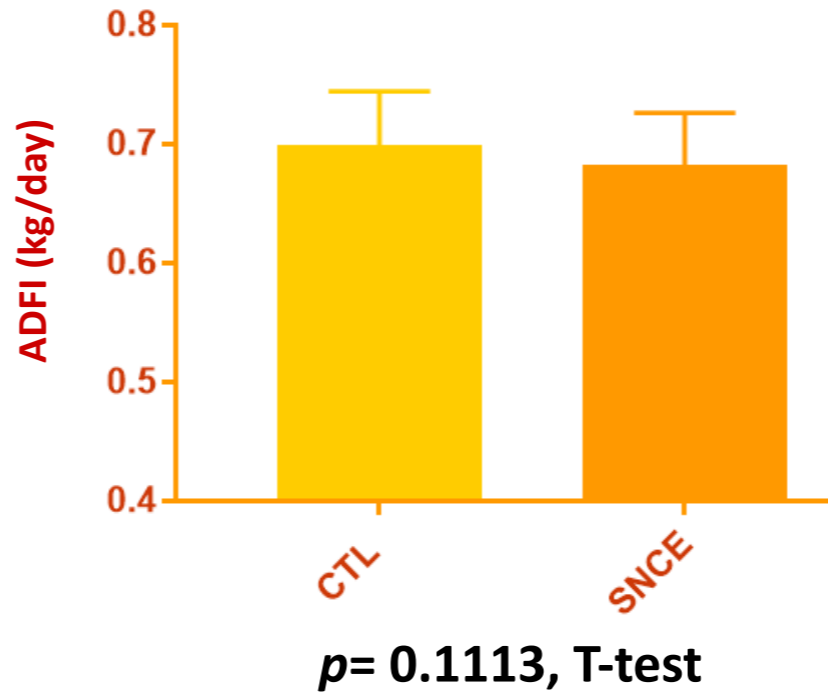
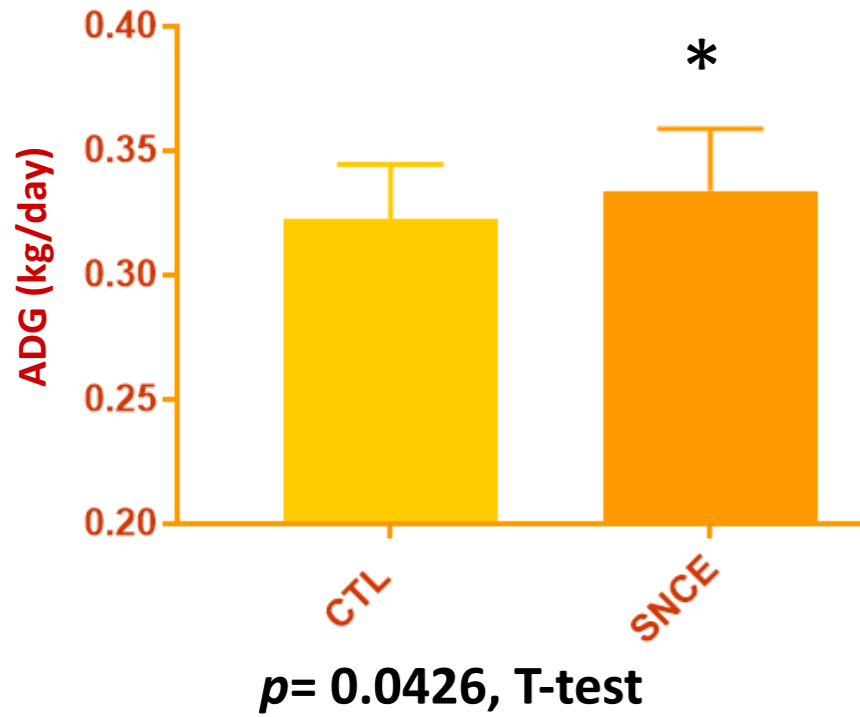
UV_{280nm} profile (Secondary metabolites) of 5 different SNCE batches manufactured over 2 years

No inter batches variation in the composition of SNCE

Results

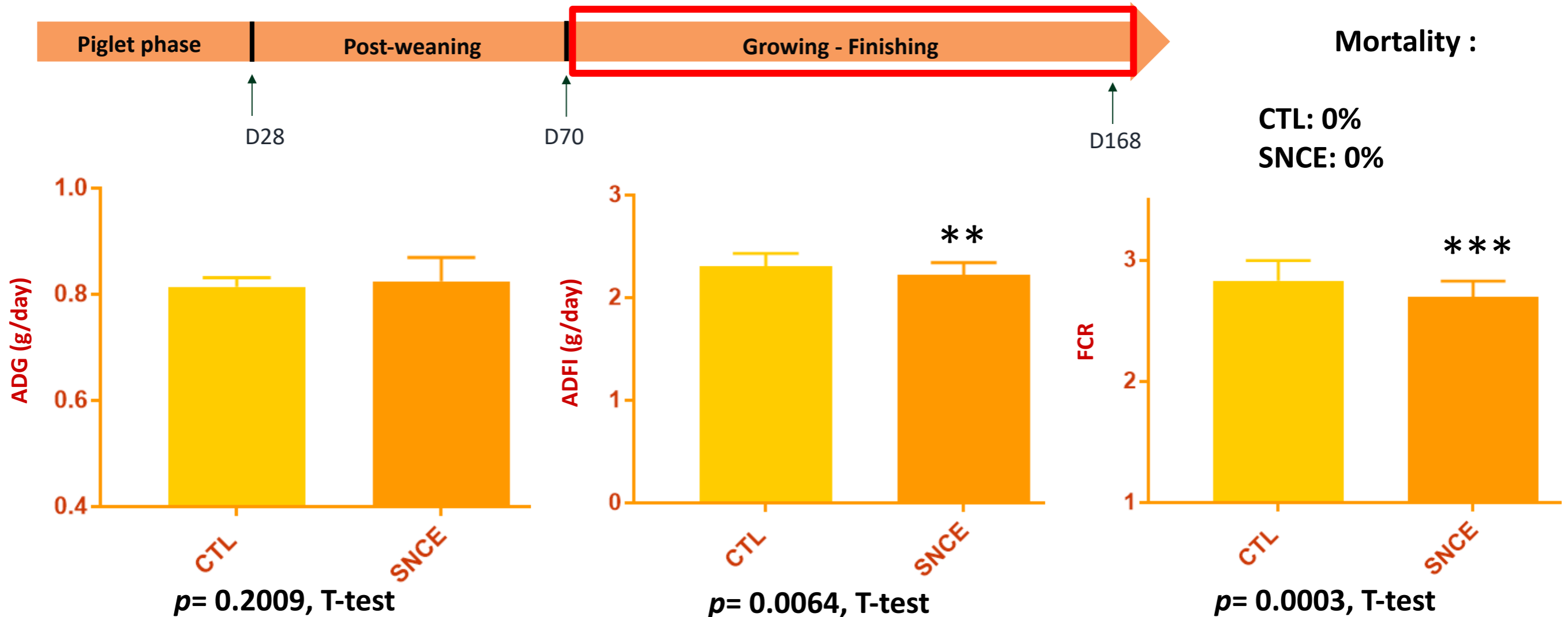


2 – Evaluation of SNCE dietary supplementation effect on weaned piglets' growth performances



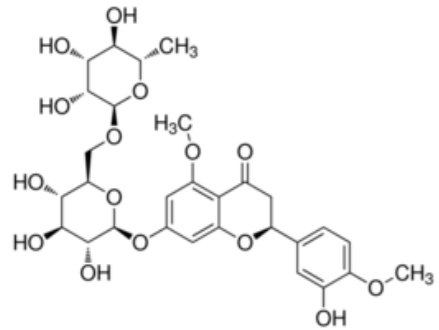
Results

2 – Evaluation of SNCE dietary supplementation effect on weaned piglets' growth performances



Results

Hesperidin



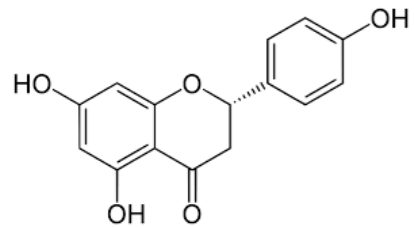
Stimulation of short-chain fatty acid production (acetate and butyrate),

Inhibition of the growth of pathogenic bacteria (Unno et al, 2015)

Stimulation of the growth of Lactobacilli (Estruel-Amades et al, 2019)

Stimulation of the growth of bifidobacteria (Gwiazdowska et al, 2015)

Change in the fatty acid profile in chicken (Hager-Theodorides et al, 2021)



Stimulation of short-chain fatty acid production (acetate, butyrate and volatile fatty acids) (Shengyong et Zhu, 2011)

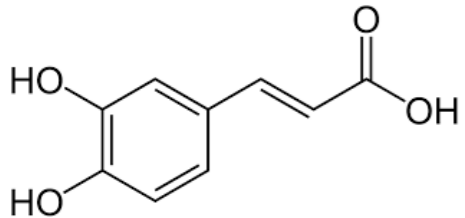
Inhibition of growth of certain pathogenic strains (including *E. coli* and *S. aureus*) (Parkar et al, 2008)

Caffeic acid

Action in intestinal morphology by stimulating the production of chlorogenic acid (Zhang et al, 2018):

Increased of the height of intestinal villi

Increased of the ratio Villus Height: Crypt Depth...



Conclusion



1 - SNCE Characterization

SNCE is a **standardized** product

- No variation in terms of composition
- No variation in terms of concentration of active compounds

SNCE is a **characterized** product

- Pectic oligosaccharides as major SNCE compounds
- More than 30 secondary metabolites



Strong hypothesis regarding its mode of action

2 – Evaluation of SNCE dietary supplementation effect on weaned piglets' growth performances

Positive effect of SNCE on piglets' growth performances during post-weaning and finishing period :

- Bodyweight gain
- FCR





Take-home messages:

Citrus based product characterization is essential to:

- Better understand the variability of supplementing them in animal performances
 - Better understand their mode of action
 - Assess their standardization



Thank you for your attention