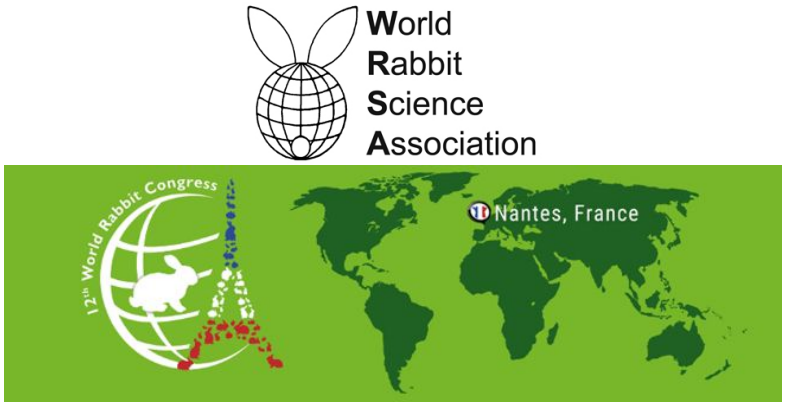

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Gohier C., Menini F.X., Bourdillon A.

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Full text of the communication

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EFFECT OF A FEED SUPPLEMENTED WITH CUNIDIGEST® ON FATTENING RABBIT PERFORMANCES

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ABSTRACT

Six consecutive trials were conducted in order to assess the effect of Cunidigest®, a nutritional complementary based on organic acids and essentials oils, on fattening rabbits. Each experiment was designed with two dietary treatments: one Control group (Control) received a commercial fattening feed and one experimental group (Cunidigest®) received the same feed supplemented with 0.5% of Cunidigest®. A mortality reduction was observed in five trials (-0.4 percentage units in trial 1, NS; -9 percentage units in trial 2, P<0.001; -4.5 percentage units in trial 3, P<0.10; -5 percentage units in trial 4, P<0.01; and -6.9 percentage units in trial 5, P<0.01). In the last trial, significant morbidity and Sanitary Risk Index (SRI) reductions were observed (P<0.05). Growing performance, feed intake and feed conversion ratio were not affected. According to these results, it may be concluded that the addition of Cunidigest® at 0.5% in diet improves rabbit viability without affecting growing performance.

Key words: Rabbit, Health status, Organic acids, Essential oils, Cunidigest®

INTRODUCTION

Organic acids are commonly used in animal nutrition. They are given different mechanisms such as improving palatability, feed efficiency and mineral absorption (Papatsiros and Christodoulopoulos, 2011). They are also recognized for their antimicrobial activity which helps to struggle against pathogens causing digestive issues (Castrovilli, 1991; Cardinali *et al.*, 2008; Gohier *et al.*, 2017). The type of acid used has a major influence on the zootechnical response generated (Papatsiros and Christodoulopoulos, 2011). Furthermore, essential oils, which most of them have been identified as natural antimicrobials, represent a relevant way to reduce pathogenic bacterial pressure (Simitzis, 2017). It has become a common practice to use it in livestock diets. These allegations seem to be fully relevant in rabbit farming since digestive disorders represent the main cause of morbidity and generate most of mortality losses (Licois, 1992). The inclusion of both organic acids and essential oils in livestock diets has already shown benefits in some species such as broiler chickens (Yang *et al.*, 2018). Since studies in rabbit production remain less documented, the objective of this trial is to evaluate the effect of a rabbit feed supplemented with Cunidigest®, an association of organic acids and essential oils, on fattening rabbits growing results and health status.

MATERIALS AND METHODS

Animals and experimental design

Four trials (trials 1 to 4) were conducted on four different commercial farms and two others (trials 5 and 6) were performed on a private farm (Mixscience Research Center, Saint Symphorien, France). In each trial, two different homogeneous groups were allotted at weaning period depending on weaning weight, does parity number and origin of litter. A control group received a commercial fattening feed and an experimental group received the same feed supplemented with 0.5% of Cunidigest®, a nutritional complementary based on essential oils extracts, organic acids and sepiolite manufactured by Mixscience (Avril group, Bruz, France).

Experimental conditions are described in Table 1. Rabbits were housed collectively. Each pen was weighed three times during a trial: at weaning, in the middle and at the end of the fattening period. Feed consumption was measured in trials 1, 5 and 6. Mortality was monitored daily, causes of mortality were reported in trials 1, 2, 3, 5 and 6. Morbidity was registered daily in trials 5 and 6, a SRI was then calculated according to the method described in Gidenne *et al.* (2012). In trial 1, mortality was taken into account for consumptions calculations considering that a rabbit consumes until two days before its death in case of digestive mortality or until the day of its death otherwise. In case of mortality during trials 5 and 6, feed quantity dispensed was adjusted according to the number of rabbits per housing (not necessary in other trials as the feed regulation method was based on duration).

Table 1: Experimental conditions

	Genetic female line	Number of rabbits in each group (Number of pens)	Feed regulation method	Fattening period (d) (intermediate weighing)
Trial 1	Hycole	288 (36)	Duration	35-72 (50)
Trial 2	Hycole	288 (36)	Duration	35-72 (50)
Trial 3	Hycole	288 (36)	Duration	35-72 (50)
Trial 4	Hyplus	360 (40)	Duration	32-62 (53)
Trial 5	Hyplus	168 (24)	Quantitative	32-71 (51)
Trial 6	Hyplus	168 (24)	Quantitative	32-71 (51)

Statistical Analysis

Growth performances, feed intake and feed conversion ratio were processed with a covariate analysis with weaning weight as a covariate using R software (version 3.6.1). The mortality data was compared by a comparison of frequency (Chi²).

RESULTS AND DISCUSSION

Health Status

Results are shown in Table 2. In trial 1, mortality rates, mainly due to digestive troubles, were low in both groups and achieved 2.8% in Control group and 2.4% in Cunidigest® group (NS). Trials 2, 3, 4 and 5 have shown significant mortality reductions in Cunidigest® groups: respectively -9 percentage units (P<0.001), -4.5 percentage units (P<0.10), -5 percentage units (P<0.01) and -6.9 percentage units (P<0.05). In trials 2, 3 and 5, the total mortality reduction was essentially digestive: respectively -9.3 percentage units (P<0.001), -4.6 percentage units (P<0.10) and -6.9 percentage units (P<0.05). In trial 5, SRI was improved by 11.9 percentage units in Cunidigest® group (P<0.01). In trial 6, neither total mortality rates nor digestive mortality were significantly different. However, the morbidity rate was lower in Cunidigest® group (-8.9 percentage units, P<0.05) on account of an Epizootic rabbit enteropathy

Table 2: Effect of Cunidigest® addition on sanitary results

	Group		
	Control	**Cunidigest®**	**P-value**
Trial 1			
Total mortality rate (%)	2.8	2.4	NS
Digestive mortality (%)	2.4	2.4	NS
Trial 2			
Total mortality rate (%)	14.9	5.9	P<0.001
Digestive mortality (%)	13.5	4.2	P<0.001
Trial 3			
Total mortality rate (%)	13.2	8.7	P<0.10
Digestive mortality (%)	11.5	6.9	P<0.10
Trial 4			
Total mortality rate (%)	6.9	1.9	P<0.01
Trial 5			
Total mortality rate (%)	11.3	4.4	P<0.05
Digestive mortality (%)	11.3	4.4	P<0.05
Diarrhea (%)	*5.7*	*1.9*	P<0.10
Epizootic rabbit enteropathy (%)	*5.0*	*1.9*	P<0.10
Paresis (%)	*0.6*	*0.6*	*NS*
Total Morbidity (%)	13.8	8.8	NS
Diarrhea (%)	*2.5*	*1.9*	*NS*
Epizootic rabbit enteropathy (%)	*11.3*	*6.9*	*NS*
SRI (%)	25.1	13.2	P<0.01
Trial 6			
Total mortality rate (%)	10.1	9.5	NS
Digestive mortality (%)	10.1	9.5	NS
Diarrhea (%)	*3.6*	*3.0*	*NS*
Epizootic rabbit enteropathy (%)	*3.0*	*4.7*	*NS*
Paresis (%)	*3.5*	*1.8*	*NS*
Total Morbidity (%)	20.8	11.9	P<0.05
Diarrhea (%)	*2.4*	*2.4*	*NS*
Epizootic rabbit enteropathy (%)	*17.8*	*8.3*	*P<0.01*
Paresis (%)	*0.0*	*0.0*	*NS*
Other (%)	*0.6*	*1.2*	*NS*
SRI (%)	30.3	20.2	P<0.05

NS: Not significantly different (P>0.05)

reduction (-9.5 percentage units, P<0.01) in this group. SRI was then improved by 10.1 percentage units in Cunidigest® group (P<0.05).

Growth performance

Results are shown in Table 3. Final live weights and average daily gain (ADG) from weaning (35 days of age in trials 1, 2, 3 and 32 days of age in trials 4, 5 and 6) until the end of fattening (72 days of age in trials 1, 2, 3; 62 days of age in trial 4 and 71 days of age in trials 5 and 6) did not reveal either a group effect or an interaction between the group and the trial suggesting that growth performance was not affected by dietary treatment. Intermediate live weights and ADG from weaning until intermediate weighing did not reveal any significant group effect but an interaction effect since intermediate live weights were higher for control groups in trials 1, 2, 3, 5 and 6 (respectively +63g, +7g, +38g, +1g and +5g) and lower in trial 4 (-61g). The same observation was made regarding ADG from intermediate weighing until the end of fattening. Feed intake and feed conversion ratio (FCR) measured in trials 1, 5 and 6, did not emphasis any group effect excepted an interaction effect for feed intake. As a matter of fact, feed consumptions were higher for control group in trial 1 (+4g/d), this could explain the higher ADG from weaning until the end of fattening observed for this group, and almost the same in trials 5 and 6 (respectively +0.3/d and -0.7/d).

CONCLUSIONS

This study led to the conclusion that Cunidigest® appears to be a convenient solution to contribute to reduce digestive troubles in rabbit production since it contributes to reduce digestive mortalities without compromising growth performance.

ACKNOWLEDGEMENTS

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Table 3: Effect of Cunidigest® addition on growth performance in 6 trials.

	Trial 1		**Trial 2**		**Trial 3**		**Trial 4**		**Trial 5**		**Trial 6**		Group Effect *(P value)*	Interaction Group*Trial *(P value)*	RCV (%)
	Control	**Cunid.***	**Control**	**Cunid.**	**Control**	**Cunid.**	**Control**	**Cunid.**	**Control**	**Cunid.**	**Control**	**Cunid.**			
Initial weight (g)	1087	1084	1012	1014	1008	1009	778	775	1010	1007	995	990	0.81	0.99	7.10
Intermediate live weight (g)	1873	1810	1758	1751	1610	1572	1671	1732	1890	1889	1894	1889	0.99	<0.001	3.88
Final live weight (g)	2684	2616	2773	2736	2573	2496	2058	2019	2729	2732	2802	2768	0.28	0.25	4.12
ADG weaning-intermediate weighing (g/d)	52.4	48.4	49.7	49.1	40.1	37.5	42.6	45.5	46.3	46.4	47.3	47.3	0.99	<0.001	8.50
ADG Intermediate weighing-end fattening (g/d)	36.9	36.6	46.1	44.8	43.8	42.0	43.0	32.0	41.9	42.1	45.4	43.9	0.38	<0.001	14.2
ADG Weaning-End of fattening (g/d)	43.1	41.4	47.6	46.5	42.3	40.2	42.7	41.5	44.1	44.2	46.3	45.6	0.32	0.30	6.02
Feed intake (g/d)	138	134							132	131	143	144	0.51	<0.05	3.42
Feed conversion ratio	3.20	3.24							3.00	2.98	3.10	3.16	0.06	0.25	5.03

* Cunid. = Cunidigest® ; *RCV, %:= residual coefficient of variation*

EFFECT OF A FEED SUPPLEMENTED WITH CUNIDIGEST® ON FATTENING RABBIT PERFORMANCES

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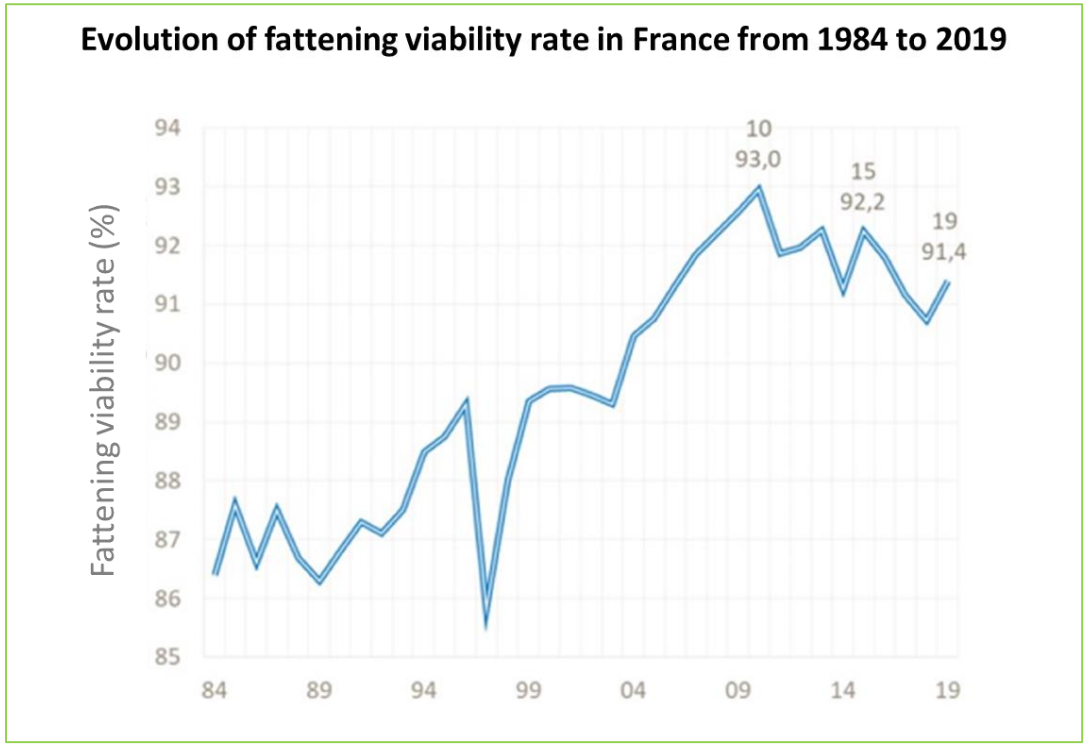
mixscience
INNOVATE FOR LIFE

Avril

Context : European rabbit production seeks to improve technical performance

- Example of French rabbit production :
  - Continuing progress in reducing the use of antibiotics *(National Demedication Plan in 2011, CLIPP)*
  - …while rabbits viability rate seems to reach a maximum threshold *(ITAVI 2020)*



Necessity to find out technical solutions in order to help rabbit farms to face these challenges

Context : Nutrition, a lever for action

- Use of Organic Acids (SCFA and MCFA)
  - Palatibility, feed efficiency, and mineral absorption (Papatsiros and Christodoulopoulos, 2011).
  - Antimicrobial activity helps to struggle against pathogens causing digestive issues (Castrovilli, 1991; Cardinali et al., 2008; Gohier et al., 2017)
  - Zootechnical response (Papatsiros and Christodoulopoulos, 2011)

- Use of of Essential Oils (Terpenoids)
  - Natural antimicrobials (Simitzis, 2017)

→ Inclusion of both organic acids (SCFA and MCFA) and essential oils (Terpenoids) in livestock diets has already shown benefits in some species such as broiler chickens (Yang and al., 2018)

What about Rabbits ?

We designed CUNIDIGEST®, an association of Organic acids (SCFA and MCFA) and Essential Oils (Terpenoids)

Materials and Methods

- Six trials
- For each trial :
  - Two different homogeneous groups were allotted at weaning period according kits weight, does parity number and origin of litter.
  - A **control group received a commercial fattening feed** and an **experimental group received the same feed supplemented with 0.5% of Cunidigest®**

		Genetic female line	Number of rabbits in each group (Number of pens)	Feed regulation method	Fattening period (d) (intermediate weighing)	Growing performances	Feed intake	Viability
Trial 1	Commercial farm 1	Hycole	288 (36)	Duration	35-72 (50)	✓	✓	✓
Trial 2	Commercial farm 2	Hycole	288 (36)	Duration	35-72 (50)	✓	-	✓
Trial 3	Commercial farm 3	Hycole	288 (36)	Duration	35-72 (50)	✓	-	✓
Trial 4	Commercial farm 4	Hyplus	360 (40)	Duration	32-62 (53)	✓	-	✓
Trial 5	Private Research center	Hyplus	168 (24)	Quantitative	32-71 (51)	✓	✓	✓
Trial 6		Hyplus	168 (24)	Quantitative	32-71 (51)	✓	✓	✓

Results and Discussion: Health Status

COMMERCIAL FARM TRIALS	Control	Cunidigest®	Difference	P-value
Trial 1				
Total viability rate (%)	97.2	97.6	+0.4	NS
Trial 2				
Total viability rate (%)	85.1	94.1	+9	**P<0.001**
Trial 3				
Total viability rate (%)	86.8	91.3	+4.5	**P<0.10**
Trial 4				
Total viability rate (%)	93.1	98.1	+5	**P<0.01**

Results and Discussion: Health Status

COMMERCIAL FARM TRIALS	Control	Cunidigest®	Difference	P-value
Trial 1				
Total viability rate (%)	97.2	97.6	+0.4	NS
Digestive mortality (%)	*2.4*	*2.4*	*0*	*NS*
Trial 2				
Total viability rate (%)	85.1	94.1	+9	**P<0.001**
Digestive mortality (%)	*13.5*	*4.2*	*-9.3*	***P<0.001***
Trial 3				
Total viability rate (%)	86.8	91.3	+4.5	**P<0.10**
Digestive mortality (%)	*11.5*	*6.9*	*-4.6*	***P<0.10***
Trial 4				
Total viability rate (%)	93.1	98.1	+5	**P<0.01**

Results and Discussion: Health Status

RESEARCH CENTER TRIALS	Control	Cunidigest®	Difference	P-value
Trial 5				
Total viability rate (%)	88.7	95.6	+6.9	**P<0.05**

Results and Discussion: Health Status

RESEARCH CENTER TRIALS	Control	Cunidigest®	Difference	P-value
Trial 5				
Total viability rate (%)	88.7	95.6	+6.9	**P<0.05**
Digestive mortality (%)	*11.3*	*4.4*	*-6.9*	***P<0.05***
Diarrhea (%)	*5.7*	*1.9*	*-3.8*	**P<0.10**
Epizootic rabbit enteropathy (%)	*5.0*	*1.9*	*-3.1*	**P<0.10**
Paresis (%)	*0.6*	*0.6*	*0*	***NS***

Results and Discussion: Health Status

RESEARCH CENTER TRIALS	Control	Cunidigest®	Difference	P-value
Trial 5				
Total viability rate (%)	88.7	95.6	+6.9	**P<0.05**
Digestive mortality (%)	*11.3*	*4.4*	*-6.9*	***P<0.05***
Diarrhea (%)	*5.7*	*1.9*	*-3.8*	**P<0.10**
Epizootic rabbit enteropathy (%)	*5.0*	*1.9*	*-3.1*	**P<0.10**
Paresis (%)	*0.6*	*0.6*	*0*	***NS***
Total Morbidity (%)	13.8	8.8	-5	**NS**
Diarrhea (%)	*2.5*	*1.9*	*-0.6*	***NS***
Epizootic rabbit enteropathy (%)	*11.3*	*6.9*	*-4.4*	***NS***
Sanitary Risk Index (%)*	25.1	13.2	-11.9	**P<0.01**

**SRI calculated according to the method described in Gidenne et al. (2012)*

Results and Discussion: Health Status

RESEARCH CENTER TRIALS	Control	Cunidigest®	Difference	P-value
Trial 6				
Total viability rate (%)	89.9	90.5	0.6	NS

Results and Discussion: Health Status

RESEARCH CENTER TRIALS	Control	Cunidigest®	Difference	P-value
Trial 6				
Total viability rate (%)	89.9	90.5	0.6	NS
Digestive mortality (%)	*10.1*	*9.5*	*-0.6*	*NS*
Diarrhea (%)	*3.6*	*3.0*	*-0.6*	*NS*
Epizootic rabbit enteropathy (%)	*3.0*	*4.7*	*1.7*	*NS*
Paresis (%)	*3.5*	*1.8*	*-1.7*	*NS*

Results and Discussion: Health Status

RESEARCH CENTER TRIALS	Control	Cunidigest®	Difference	P-value
Trial 6				
Total viability rate (%)	89.9	90.5	0.6	NS
Digestive mortality (%)	*10.1*	*9.5*	*-0.6*	*NS*
Diarrhea (%)	*3.6*	*3.0*	*-0.6*	*NS*
Epizootic rabbit enteropathy (%)	*3.0*	*4.7*	*1.7*	*NS*
Paresis (%)	*3.5*	*1.8*	*-1.7*	*NS*
Total Morbidity (%)	20.8	11.9	-8.9	**P<0.05**
Diarrhea (%)	*2.4*	*2.4*	*0*	*NS*
Epizootic rabbit enteropathy (%)	*17.8*	*8.3*	*-9.5*	***P<0.01***
Paresis (%)	*0.0*	*0.0*	*0*	*NS*
Other (%)	*0.6*	*1.2*	*0.6*	*NS*
SRI (%)*	30.3	20.2	-10.1	**P<0.05**

**SRI calculated according to the method described in Gidenne et al. (2012)*

Results and Discussion : Growth Performances

	Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6		P0 Effect *(P value)*	Group Effect *(P value)*	Interaction Group*Trial *(P value)*	RCV (%)
	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®				
Intermediate live weight (g)	1873	1810	1758	1751	1610	1572	1671	1732	1890	1889	1894	1889	**<0.001**	0.99	**<0.001**	3.88
Final live weight (g)	2684	2616	2773	2736	2573	2496	2058	2019	2729	2732	2802	2768	**<0.001**	0.28	0.25	4.12

- Trial 1 = Farm where global mortality rate was the lowest (2.6%)

→ Reduced intermediate live weight with Cunidigest due to immune system modulation ? (Cardinali R et al., 2008)

- Trial 4 = Early weaning, weight of rabbits was low at the beginning of the trial (average initial weight at 32 days : 777g)

→ Higher intermediate live weight with Cunidigest due to a better microbiota implementation ? (Simitzis, 2017)

P0 : initial weight
RCV (%) : residual coefficient of variation

Results and Discussion : Growth Performances

	Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6		P0 Effect *(P value)*	Group Effect *(P value)*	Interaction Group*Trial *(P value)*	RCV (%)
	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®				
Intermediate live weight (g)	1873	1810	1758	1751	1610	1572	1671	1732	1890	1889	1894	1889	**<0.001**	0.99	**<0.001**	3.88
Final live weight (g)	2684	2616	2773	2736	2573	2496	2058	2019	2729	2732	2802	2768	**<0.001**	0.28	0.25	4.12

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- Trial 4 = Early weaning, weight of rabbits was low at the beginning of the trial (average initial weight at 32 days : 777g)

→ Higher intermediate live weight with Cunidigest due to a better microbiota implementation ? (Simitzis, 2017)

- Final live weight : only a P0 effect (initial weight)

→ Numerical differences can be explained as in Cunidigest groups, more « small and weak» rabbits remained alive while growing performances were similar between Control and Cunidigest groups

P0 : initial weight
RCV (%) : residual coefficient of variation

Results and Discussion : Growth Performances

	Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6		P0 Effect *(P value)*	Group Effect *(P value)*	Interaction Group*Trial *(P value)*	RCV (%)
	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®				
Intermediate live weight (g)	1873	1810	1758	1751	1610	1572	1671	1732	1890	1889	1894	1889	**<0.001**	0.99	**<0.001**	3.88
Final live weight (g)	2684	2616	2773	2736	2573	2496	2058	2019	2729	2732	2802	2768	**<0.001**	0.28	0.25	4.12
ADG Weaning-Intermediate weighing (g/d)	52.4	48.4	49.7	49.1	40.1	37.5	42.6	45.5	46.3	46.4	47.3	47.3	0.14	0.99	**<0.001**	8.50
ADG Intermediate weighing-End of fattening (g/d)	36.9	36.6	46.1	44.8	43.8	42.0	43.0	32.0	41.9	42.1	45.4	43.9	**<0.05**	0.38	**<0.001**	14.2
ADG Weaning-End of fattening (g/d)	43.1	41.4	47.6	46.5	42.3	40.2	42.7	41.5	44.1	44.2	46.3	45.6	0.44	0.32	0.30	6.02

- Final live weight : only a P0 effect (initial weight)

→ Numerical differences can be explained as in Cunidigest groups, more « small and weak» rabbits remained alive while growing performances were similar between Control and Cunidigest groups

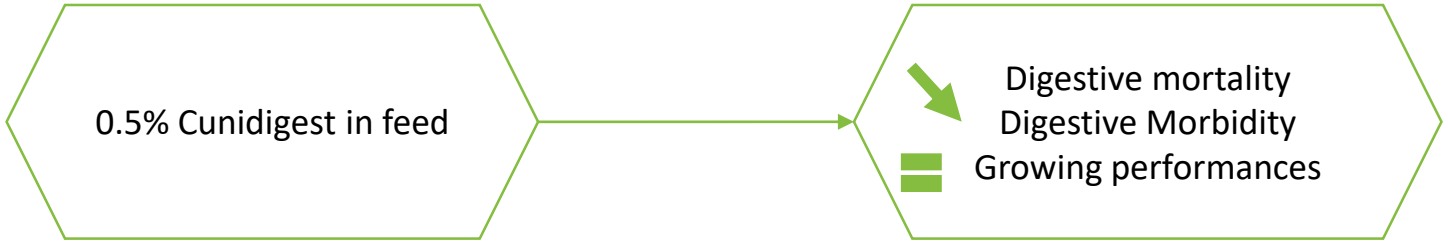
P0 : initial weight
RCV (%) : residual coefficient of variation

Results and Discussion : Growth Performances

	Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6		P0 Effect *(P value)*	Group Effect *(P value)*	Interaction Group*Trial *(P value)*	RCV (%)
	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®	Control	Cunidigest®				
Intermediate live weight (g)	1873	1810	1758	1751	1610	1572	1671	1732	1890	1889	1894	1889	**<0.001**	0.99	**<0.001**	3.88
Final live weight (g)	2684	2616	2773	2736	2573	2496	2058	2019	2729	2732	2802	2768	**<0.001**	0.28	0.25	4.12
ADG Weaning-Intermediate weighing (g/d)	52.4	48.4	49.7	49.1	40.1	37.5	42.6	45.5	46.3	46.4	47.3	47.3	0.14	0.99	**<0.001**	8.50
ADG Intermediate weighing-End of fattening (g/d)	36.9	36.6	46.1	44.8	43.8	42.0	43.0	32.0	41.9	42.1	45.4	43.9	**<0.05**	0.38	**<0.001**	14.2
ADG Weaning-End of fattening (g/d)	43.1	41.4	47.6	46.5	42.3	40.2	42.7	41.5	44.1	44.2	46.3	45.6	0.44	0.32	0.30	6.02
Feed intake (g/d)	138	134	-	-	-	-	-	-	132	131	143	144	0.10	0.51	**<0.05**	3.42
Feed conversion ratio	3.20	3.24	-	-	-	-	-	-	3.00	2.98	3.10	3.16	**<0.001**	0.06	0.25	5.03

P0 : initial weight
RCV (%) : residual coefficient of variation

Conclusion



- **Perspectives inspired from Simitzis (2017) :**
  Enrichment of Animal Diets with Essential Oils—A Great Perspective on Improving Animal Performance and Quality Characteristics of the Derived Products

According to autopsies : Non-specific diarrhea and Epizootic rabbit enteropathy were targeted with Cunidigest®

- **Should focus the study on microbiota development**
  → controlling pathogens, gut microbiota stabilization, feed digestion improvement

Performances of Essential oils : terpenoids were tested here, what about phenylpropanoids ? (optimal combination ? , dosage ?, …)

- **Recommendation :**
  - **using Cunidigest® from the beginning of fattening feed distribution…**
    → changes of composition of the caecal microbiota (end of milk intake, weaning, etc…)
  - **…until the end**
    → feed transition, end of fattening period prevented from any antibiotic use

Thank for your attention !

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