LIFE15 ENV/GR/257

Lessons learned from the LIFE-F4F project on the utilization of catering waste as feed additive for poultry, pigs and pets (cats and dogs)

https://life-f4f.esdak.gr/en/

Presentation by:

Prof. Katia Lasaridi

Harokopio University

klasaridi@hua.gr

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Food for Feed: An Innovative Process for Transforming Hotels' Food Waste into Animal Feed

Project Partners

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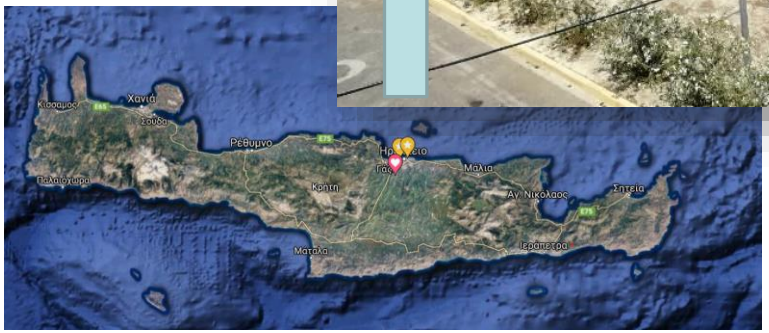
Project Overview

- The LIFE-F4F project aimed to evaluate an innovative low-emission technology for the safe transformation of food waste from the hospitality sector, into animal feed.
- A pilot-scale demonstration, using a solar energy to pasteurise and dry food waste.
- Tested the product as a feed additive for pets (cats and dogs), poultry and pigs.
- 1/9/2016-30/11/2021

Main project's actions

- Development of the Source Separated Food Waste Collection System
- Development of the F4F Pilot Unit
- Initiating, Operating and Optimizing the F4F System
- Evaluating the Produced Feed for Pigs and Poultry Husbandry
- Evaluating the Produced Feed as Pet Food
- Sustainability evaluation and policy implications

The F4F pilot unit …



The pretreatment unit …

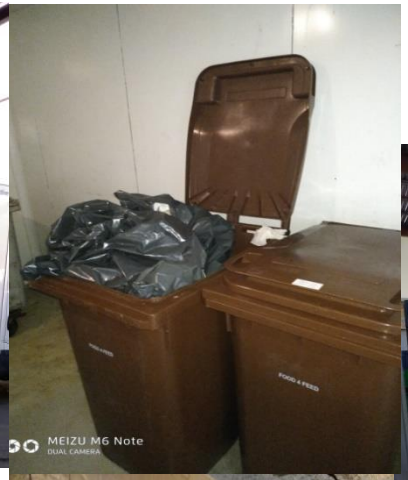
The solar drying unit …

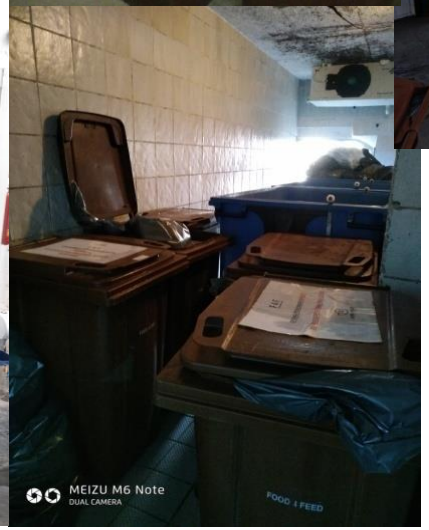
Horizontal turner

Vertical turner

The F4F Flow Chart

During food waste collection…





In the pretreatment unit …

Weighting - Hand sorting – Shredding - Pulverizing

Food waste weighting

Sorting belt

Shredder

Pulverizer

Product before the solar drying tank

In the Solar drying unit…

Total F4F product … as feed component…

The initial moisture of the collected food waste is about 75 – 80% and the final moisture of the dried product is up to 12%.

Average drying rate: **6-7 days**

The F4F product …. in animal trials as feed component…. with promising results

First experimental trial for broilers

- Duration of experiment: 42 days
- Housing and care of broilers complying with directive 2010/63/EC on the protection of animals used for scientific purposes
- Pen was the experimental unit
- Ten (10) replicate pens of two (2) dietary treatments, control (C) and treatment (T)
- 10 broilers per pen, i.e.,100 per treatment
- In-house environmental conditions (light and ventilation) were controlled
- Heat was provided with a heating lamp per pen


4th_virtual project visit_2020/05/25

Diets

To meet Ross 308 requirements

- According to age, broilers were fed three different diets, namely starter (0 - 10 days), grower (11 - 24 d) and finisher (25 - 42 d)
- In C treatment, broilers were fed a basal diet based on corn and soybean meal with no feed waste product added.
- In T treatment, the FW derived product was added to starter, grower and finisher diet at a level of 15%.
- Diets are isonitrogenous and isocaloric
- Provided in mash

Determination of Performance parameters

On onset and at the end of each phase

- Broilers body weight (BW) was recorded, and the mean body weight gain (MWG) was calculated
- Feed intake was measured (MFC) and feed to gain ratios (FCR) was calculated
- Broilers were inspected daily, and any mortality was recorded

Determination of Carcass yield and quality

At the end of the 6th week, a representative number of chickens per treatment were sacrificed to investigate treatment effects on

- Carcass yield
- Carcass quality (pH, colour, cooking loss and shear force)
- Meat fatty acid profile

Composition (%), determined and calculated analysis of the experimental broiler diets

Ingredients	Control Starter	Treatment Starter	Control Grower	Treatment Grower	Control Finisher	Treatment Finisher
Food waste	-	15	-	15	-	15
Maize	48.50	45.14	52.12	47.97	57.62	53.47
Soybean meal	42.83	34.21	38.98	31.19	33.43	25.64
Vitamin and Mineral Premix	0.20	0.20	0.20	0.20	0.20	0.20
Limestone	0.84	0.55	0.78	0.48	0.74	0.45
NaCl	0.37	0.07	0.37	0.07	0.37	0.07
Methionine	0.36	0.39	0.31	0.33	0.27	0.28
Soybean oil	4.46	1.64	5.17	2.45	5.59	2.86
Lysine	0.24	0.37	0.17	0.28	0.16	0.27
Threonine	0.10	0.24	0.07	0.11	0.04	0.09
Monocalcium Phosphate	2.02	2.06	1.76	1.80	1.50	1.54
Choline	0.08	0.13	0.07	0.12	0.08	0.13
Determined composition (%)						
Dry matter	88.74	88.55	89.23	88.45	89.30	89.25
Ash	5.87	5.60	5.52	5.25	4.95	4.47
Crude protein	22.82	22.69	21.98	21.02	18.88	18.67
Ether extract	5.88	6.02	6.32	7.09	7.25	7.71
Crude fibre	4.00	4.01	3.82	3.66	3.29	3.02
Calculated Analysis						
ME (MJ/kg)	12.55	12.55	12.97	12.97	13.39	13.39
Sodium (g/kg)	1.6	1.6	1.6	1.6	1.6	1.6
Ca (g/kg)	9.6	9.6	8.7	8.7	7.8	7.8
Available P (g/kg)	4.8	4.8	4.4	4.4	3.9	3.9
Lysine (g/kg)	14.4	14.4	12.9	12.9	11.5	11.5
Methionine+ cysteine (g/kg)	10.8	10.8	9.9	9.9	9.0	9.0
Threonine (g/kg)	9.7	10.5	8.8	8.8	7.8	7.8

Performance of broilers

	C	T	P- value
Initial BW (g)	40.05	39.75	NS
Final BW 42d (g)	3,098.2	2,794.1	<0.001
MWG (g)	3,058.1	2,754.3	<0.001
MFC (g)	4,586.9	4,289.6	0.011
FCR	1.50	1.56	NS
Mortality %	7	2	0.072
Carcass yield (%)	75.78	75.60	NS
Breast yield (%)	29.48	30.28	NS

Values are means of ten replicate pens (n = 10).
BW: body weight of broilers;
MFC: Mean feed intake of the total experimental period (0-42 days);
MBWG: Mean body weight gain of the total experimental period (0-42 days);
FCR: Feed conversion ratio (g feed/g gain) of the total experimental period (0-42 days);
NS: Statistically non-significant.

Treatment effects on internal organ weight and selected biochemical and haematological parameters

	C	T	P-value
Heart (%)	0.507	0.505	NS
Spleen (%)	0.097	0.096	NS
Liver (%)	1.60	1.59	NS
Kidney (%)	0.159	0.157	NS
Bursa of Fabricius (%)	0.199	0.194	NS
Gizzard (%)	1.25	1.22	NS
SGOT AST(IU/l)	522.3	519.3	NS
SGPT ALT (IU/l)	5.50	4.70	NS
BUN (IU/l)	1.41	0.98	NS
γ-GT (IU/l)	22.30	23.10	NS
Phosphatase (IU/l)	3207.0	2260.8	NS
Cholesterol (mg/dl)	143.3	157.5	0.049
Total proteins (g/dl)	2.80	2.71	NS
Alboumin (g/dl)	1.19	1.22	NS
Globulin (g/dl)	1.61	1.49	NS
Haematocrit (%)	29.56	29.50	NS

Treatment effects on selected parameters of carcass quality

	C	T	P-value
Color traits			
L*	56.22	54.18	0.094
a*	6.06	5.70	NS
b*	17.43	15.84	0.023
Physical traits			
pH_{24}	6.22	6.21	NS
Cooking loss (%)	13.62	12.98	NS
Shear force (100 N/mm^2)	11.81	10.85	0.081

Giamouri E., Pappas A.C., Papadomichelakis G., Simitzis P.E., Manios T., Zentek J., Lasaridi K., Tsiplakou E., Zervas G., 2022
The Food for Feed Concept: Redefining the Use of Hotel Food Residues in Broiler Diets, Sustainability 14, 6, 3659

- The potential use of food waste originating from hotels for broiler chickens' diets was examined.
- 240 one-day-old broilers were allocated into four treatment groups, namely, control (C), non-meat treatment (NM), non-sterilized treatment (NS) and sterilized treatment (S), each with 5 replicate pens of 12 broilers. The experimental period lasted 42 days.
- Several parameters were recorded throughout the experiment, such as the initial and final body weight, the feed conversion ratio (FCR), the traits, some biochemical and hematological parameters, the weight of internal organs and selected breast meat quality indices.
- The results showed **no major differences** in health parameters and the carcass quality traits. There was also no difference in growth rate between the three groups (C, NS, S), but broilers fed the NM diet (without meat remnants) had a significantly lower growth rate by 11.4% compared to the control. Food waste residues can be an alternative feedstuff for broiler chickens and can maintain performance at acceptable levels.

PIG TRIAL

First experimental trial in fattening pigs

- Duration of experiment: 46 days
- Compliant with the guidelines of the Ethical Committee of the Agricultural University of Athens and Directive 2010/63/EC on the protection of animals used for scientific purposes
- Pig was the experimental unit
- Two (2) dietary treatments tested, control (C) and treatment (DFR)
- 10 pigs per treatment

Giamouri et al., 2022. Meat Quality Traits as Affected by the Dietary Inclusion of Food Waste in Finishing Pigs, Sustainability 14, 11, 6593

- Effect of dietary inclusion of dried hotel residues (DHR) on the growth performance, blood biochemical parameters and meat quality traits in finishing pigs.
- 2 trials, 20 castrated male pigs were allotted into 2 treatments. In both trials, control treatment pigs were fed a corn-soybean meal-based diet without hotel residues.
- 1st trial, a DHR1 treatment contained 100 g DHR1/kg with meat residues (approximately 5%).
- 2nd trial, a DHR2 treatment contained 80 g DHR2/kg with no meat residues.
- Average daily feed intake tended to be lower and average daily weight gain was lower in DHR1 compared to control pigs in the first trial, while in the second no differences were detected. However, final body weight, FCR and dressing percentage were not affected in any of the two trials. Minor differences in several meat physical traits, hematological parameters were observed among treatments and trials.
- In conclusion, results indicate that the dietary addition of DHR did not affect the feed utilization and the quality of the produced meat hence, the use of DHR in pig feeding can be supported.

Evaluating the Produced Feed as Pet Food

Beneficiary responsible: ***FUB*** *(AUA, HMU, ESDAK)*

For the feeding trials with dogs and cats, diets with varying amounts of dried food residues (DFR) were used

- 0 %, 5 %, 10 % and 15 % DFR

Paßlack N., Galliou F., Manios T., Papadaki A., Markakis N., Sambathianakis I., Lasaridi K., Fortatos S., Kyriacou A., Vahjen W., Zentek J., 2021 Investigations on the use of dried food residues as a potential dietary ingredient for cats, Sustainability 13, 21, 11603

- The effects of the inclusion of dried food residues (DFR) (0, 5, 10 and 15%) in a complete diet were evaluated in seven (7) healthy adult cats.
- At the end of each 3-week feeding period, feces were collected.
- The analysis of the fecal microbiota by 16S rDNA sequencing demonstrated a marked increase of the bacterial alpha-diversity with increasing dietary inclusion levels of DFR. In addition, an increase in the relative abundance of *Coriobacteriales*, *Collinsella* and *Lachnoclostridum*, as well as of propionate and n-valerate in the feces of the cats, was detected.
- The dietary inclusion of DFR decreased the apparent crude protein digestibility and tended to decrease the apparent crude fat digestibility.
- Overall, the DFR seemed to be highly fermentable in the intestine of cats, which markedly affected the diversity of the fecal microbiota. As this effect might be critical for a balanced gut microbiota, but also along with the observed depressing effects of DFR on the apparent crude protein and crude fat digestibility, lower inclusion levels are recommended if used as a potential ingredient for cat food in the future.

Paßlack N., Galliou F., Manios T., Lasaridi K., Tsiplakou E., Vahjen W., Zentek J., 2021
Impact of the dietary inclusion of dried food residues on the apparent nutrient digestibility and the intestinal microbiota of dogs, Archives of Animal Nutrition, 75, 4, 311-327

- Four diets with 0, 5, 10 and 15% dried food residues (DFR), derived from hotel catering, were fed to 10 healthy adult dogs. At the end of each 3-week feeding period, faeces and blood were collected.
- Results demonstrated that the apparent crude protein digestibility and ether extract digestibility decreased with increasing amounts of DFR in the diets ($p<0.05$). In addition, an increase of the faecal concentrations of acetic acid, propionic acid, n-butyric acid and total short-chain fatty acids (SCFA) was observed ($p<0.05$). Faecal ammonium and lactate concentrations, as well as plasma phenol and indole concentrations, were not linearly affected by the dietary inclusion of DFR.
- The relative abundance of Fusobacteria in the faeces of the dogs decreased, and the relative abundance of Actinobacteria and Bacteroidetes increased with increasing amounts of DFR in the diets ($p<0.05$).
- In conclusion, the DFR seemed to be intensively fermented by the intestinal microbiota of the dogs, as indicated by the increased faecal SCFA concentrations and the shifts in the composition of the faecal microbiota. Dietary inclusion levels of up to 5% can be recommended based on our results, as the observed lower apparent crude protein and ether extract digestibility might limit the use of food residues for dogs at higher amounts.

Thank you for your attention

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