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SusPig – Sustainability of pig production through improved feed efficiency

Wendy Rauw

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EUROPEAN RESEARCH AREA ON SUSTAINABLE ANIMAL PRODUCTION

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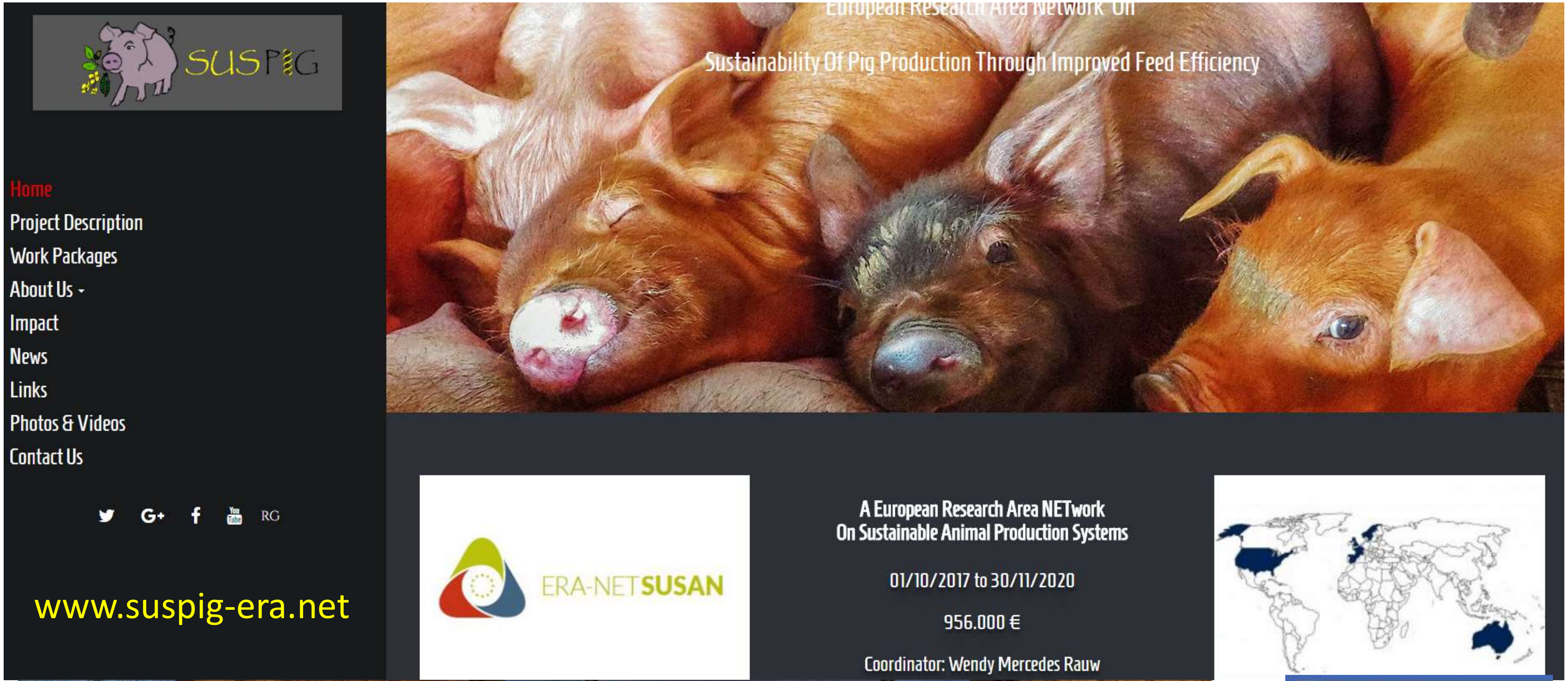
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News
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A European Research Area NETwork
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Coordinator: Wendy Mercedes Rauw


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Tweets 2
Siguiendo 5
Seguidores 3
Listas 0
Momentos 0
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Tweets
Tweets y respuestas
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SusPig ERA-Net
Page
Inbox
Notifications 3
SusPig ERA-Net
Create Page @Username
Home
Posts
Reviews
See more
Promote
Manage Promotions
Like
Welcome

Index

1. Challenge
2. Goal & Objectives
3. Consortium
4. Potential impact
5. Preliminary results
6. Stakeholders and expectations

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Index

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1. Challenge

Feed = 85% of total livestock production costs &
environmental impact

Also: Feeding more people on limited land, water, and energy

Thus: Feed efficiency is necessary

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Resource allocation:

$$\text{CFI} = b_0 + (b_1 \times BW^{0.75}) + (b_2 \times BWG) + \text{RFI}$$

$$R\ (\text{Total}) = R\ (\text{Maintenance}) + R\ (\text{Production}) + R\ (\text{Rest})$$

RFI = ‘error’ = irrelevant?

- ☞ Genetic selection can not result in improved production when this can not be supported by farm resources
- ☞ Important to monitor robustness when selecting for improved feed efficiency

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1. Challenge

Animal robustness = sustainability at animal level (welfare)

Feed efficiency = farm production

Regional & national sustainability ☞ improving feed efficiency on local feedstuffs and feedstuff co-products

This may require a different type (genetics) of animal

(Genotype x Diet interaction)

1. Challenge

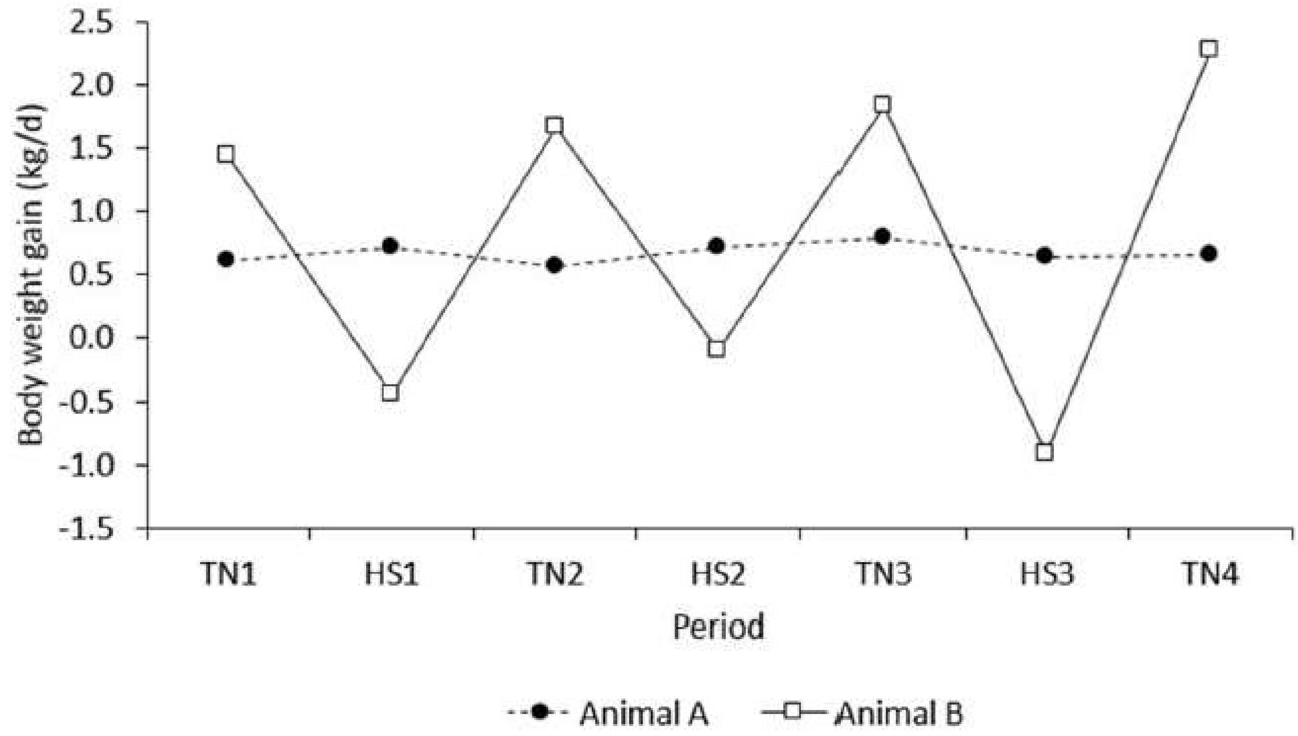

FIGURE 8 | BWG of two extreme examples of individual observations on pigs A and B that depict the negative correlation between BWG in period n with that in period n + 1.

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Index

1. Challenge
2. Goal & Objectives
3. Consortium
4. Potential impact
5. Preliminary results
6. Stakeholders and expectations

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2. Goal & Objectives

Aim: to enhance sustainability of European pig production through improved feed efficiency at different scales

The supporting objectives are to:

1) Evaluate the consequence of improved feed efficiency for fitness, to improve animal robustness (blood biomarkers, metagenomics, (heat) stress)

2) Evaluate if improved feed efficiency can be sustained with more reliance on local feed resources and feedstuff co-products (fiber, DDGS, rapeseed, legumes, acorn)

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2. Goal & Objectives

3. Evaluate the environmental, social and economic impact (Life Cycle Assessment) of improved feed efficiency on local feed resources and feedstuff co-products (DDGS, rapeseed, high fiber, legumes, acorns)

4. To develop future sustainable pig production systems

WP5 Dissemination

WP6 Project management

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Index

1. Challenge
2. Goal & Objectives
3. Consortium
4. Potential impact
5. Preliminary results
6. Stakeholders and expectations

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Index

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4. Potential impact

RA 1: Feed efficiency = improved profitability of animal production through reduced feed costs

RA 2: Improving feed efficiency of pigs in transforming low quality feed may improve local resource use and enhance the environmental sustainability of European pig production

RA 3: Understanding the implications of improving feed efficiency on animal robustness may improve animal welfare, breeding strategies and consumer acceptance of pig production and breeding practices

Index

1. Challenge
2. Goal & Objectives
3. Consortium
4. Potential impact
5. **Preliminary results**
6. Stakeholders and expectations

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A Hypothesis And Review Of The Relationship Between Selection For Improved Production Efficiency, Coping Behavior, And Domestication

WM Rauw, AK Johnson, L Gomez-Raya, JCM Dekkers

Frontiers in Genetics 2017, Volume 8, Article 134, pp 1-13

Coping styles in response to stressors have been described both in humans and in other animal species. Because coping styles are directly related to individual fitness they are part of the life history strategy. Behavioral styles trade off with other lifehistory traits through the acquisition and allocation of resources. Domestication and subsequent artificial selection for production traits specifically focused on selection of individuals with energy sparing mechanisms for non-production traits. Domestication resulted in animals with low levels of aggression and activity, and a low hypothalamic–pituitary–adrenal (HPA) axis reactivity. In the present work, we propose that, vice versa, selection for improved production efficiency may to some extent continue to favor docile domesticated phenotypes. It is hypothesized that both domestication and selection for improved production efficiency may result in the selection of reactive style animals. Both domesticated and reactive style animals are characterized by low levels of aggression and activity, and increased serotonin neurotransmitter levels. However, whereas domestication quite consistently results in a decrease in the functional state of the HPA axis, the reactive coping style is often found to be dominated by a high HPA response. This may suggest that fearfulness and coping behavior are two independent underlying dimensions to the coping response. Although it is generally proposed that animal welfare improves with selection for calmer animals that are less fearful and reactive to novelty, animals bred to be less sensitive with fewer desires may be undesirable from an ethical point of view.

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stressor, domestication specifically meant selecting for tameness, i.e., a combination of low aggression *and* low fearfulness. Interdisciplinary research provides evidence that (to some degree) animals experience emotions such as joy, fear, love, despair, and grief (Bekoff, 2000), and have the capacity for episodic memory and future planning (Zentall, 2013). Therefore, whereas human research benefits from the ability of individuals to articulate the dimensions of their coping strategies in terms of their behavioral response but also their emotion, motivation, control, and event appraisal, equating coping response with personality in animal research may delimit our understanding of animal coping strategies.

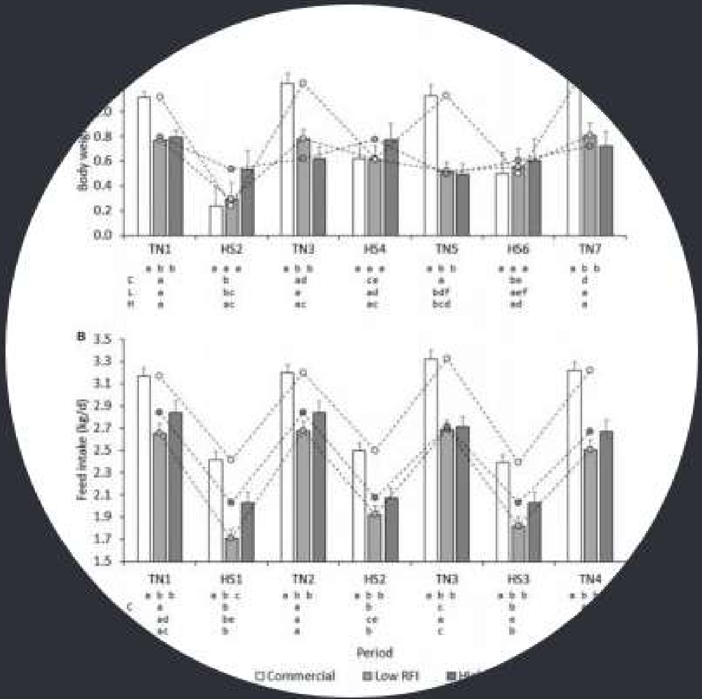
SELECTION FOR FEED EFFICIENCY IN LIVESTOCK: FURTHER DOMESTICATION?

From an energetic perspective, the process of domestication tended to reallocate resources used for processes that were no longer needed in the domesticated phenotype (vigilance, fight off predators, search for food, periods of food shortage) to increased production (meat, milk, eggs, wool, reproduction). Reduced levels of activity, aggression, and a delayed and immature HPA axis response support that trend. Subsequently, production levels further increased with conscious selection for production traits. However, when resources become limited, it is expected that a further increase in production must result in further energy sparing on traits that are not directly selected for. Therefore, it can be hypothesized that under these conditions, selection for increased production may tend to, *vice versa*, further reduce aggression, activity, and the HPA axis response. In addition, selection for improved feed efficiency is expected to emphasize this trend because it specifically reduces the overall energy budget or metabolic scope.

Indeed, as reviewed by Rauw (2012), the literature shows

for RFI, and a significantly lower bloo
in steers selected for low RFI compar
high RFI. Aleri et al. (2016) also show
concentrations in cattle were lower i
efficiency cow phenotypes than in low f
phenotypes 48 h post-yarding and han
for low RFI in the study of Luiting e
cortisol response to an ACTH challe
period, than chickens selected for high
have been reported to show a lower sen
disturbances than inefficient chickens
1978; Katle et al., 1984). In pig, Colp
that male pigs from a line selected f
shorter duration of freezing, froze less f
to escape less frequently than high-R
2014). In the same pig lines, Sadler e
gilts from the low-RFI line tended to ha
concentrations and were less responsiv
than gilts from the high-RFI line (Jenki
Knott et al. (2008) also observed tha
lower increase in cortisol concentrati
challenge.

Selection for juvenile body weight in
aggressive interactions in the study of
Schütz and Jensen (2001) suggest that se
in laying hens resulted in a concomi
interactions saving energy that could be
traits. Indeed, high efficient hens in th
Katle (1989) showed less escape and
low efficient hens. However, accordi
(2003) selection for increased egg prod
acceleration of maturity and the onse
to result in animals that are socially m
aggressive than unselected hens. Likewis
that livestock animals with a calm te
average daily gains than those with



Effects Of Diet And Genetics On Growth Performance Of Pigs In Response To Repeated Exposure To Heat Stress

WM Rauw, EJ Mayorga, SM Lei, JCM Dekkers, JF Patience, NK Gabler, SM Lonergan, LH Baumgard

Frontiers in Genetics 2017, Volume 8, Article 155, pp 1-18

Heat stress (HS) is one of the costliest issues in the U.S. pork industry. Aims of the present study were to determine the consequences of repeated exposure to HS on growth performance, and the effects of a high fiber diet, the genetic potential for high lean tissue accretion, and the genetic potential for residual feed intake (RFI) on resilience to HS. Barrows (n = 97) from three genetic lines (commercial, high RFI, low RFI) where subjected three times to a 4-day HS treatment (HS1, HS2, and HS3) which was preceded by a 9-day neutral (TN) adaptation period (TN1) and alternated by 7-day periods of neutral temperatures (TN2, TN3, and TN4). Body weight gain (BWG), feed intake (FI), feed conversion efficiency (FCE), RFI, and the drop in BWG and FI between TN and HS were estimated for each period, and slaughter traits were measured at the end of TN4. Commercial pigs had lower FI when fed a high fiber diet compared to a regular diet (2.70 ± 0.08 vs. 2.96 ± 0.08 kg/d; $P < 0.05$), while no differences were found for BWG, RFI or FCE. HS reduced FI, BWG, and FCE, increased RFI, and resulted in leaner pigs that generate smaller carcasses at slaughter. In TN, commercial pigs grew faster than the low and high RFI pigs (1.22 ± 0.06 vs. 0.720 ± 0.05 and 0.657 ± 0.07; $P < 0.001$) but growth rates were not significantly different between the lines during HS. Growth rates for the low RFI and high RFI pigs were similar both during TN and during HS. Pigs of interest for genetic improvement are those that are able to maintain growth rates during HS. Our results show that response in growth to HS was repeatable over subsequent 4-d HS cycles, which suggests the potential for including this response in the breeding index. The best performing animals during HS are likely those that are not highly superior for growth in TN.

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Index

1. Challenge
2. Goal & Objectives
3. Consortium
4. Potential impact
5. Preliminary results
6. Stakeholders and expectations

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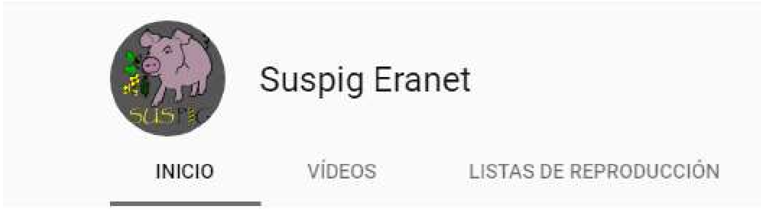

6. Stakeholders and expectations

Life Cycle Assessment (WP3 & WP4) based on literature, available information, novel experiments

☞Stakeholder inputs

- perception of the future in different regions

= Feed producers, pig producer associations, pig breeders, farmers, ministry of agriculture, citizens living in the region, ecologists, retailers, consumers, the pig

Results & new production system(s) ☞ stakeholders

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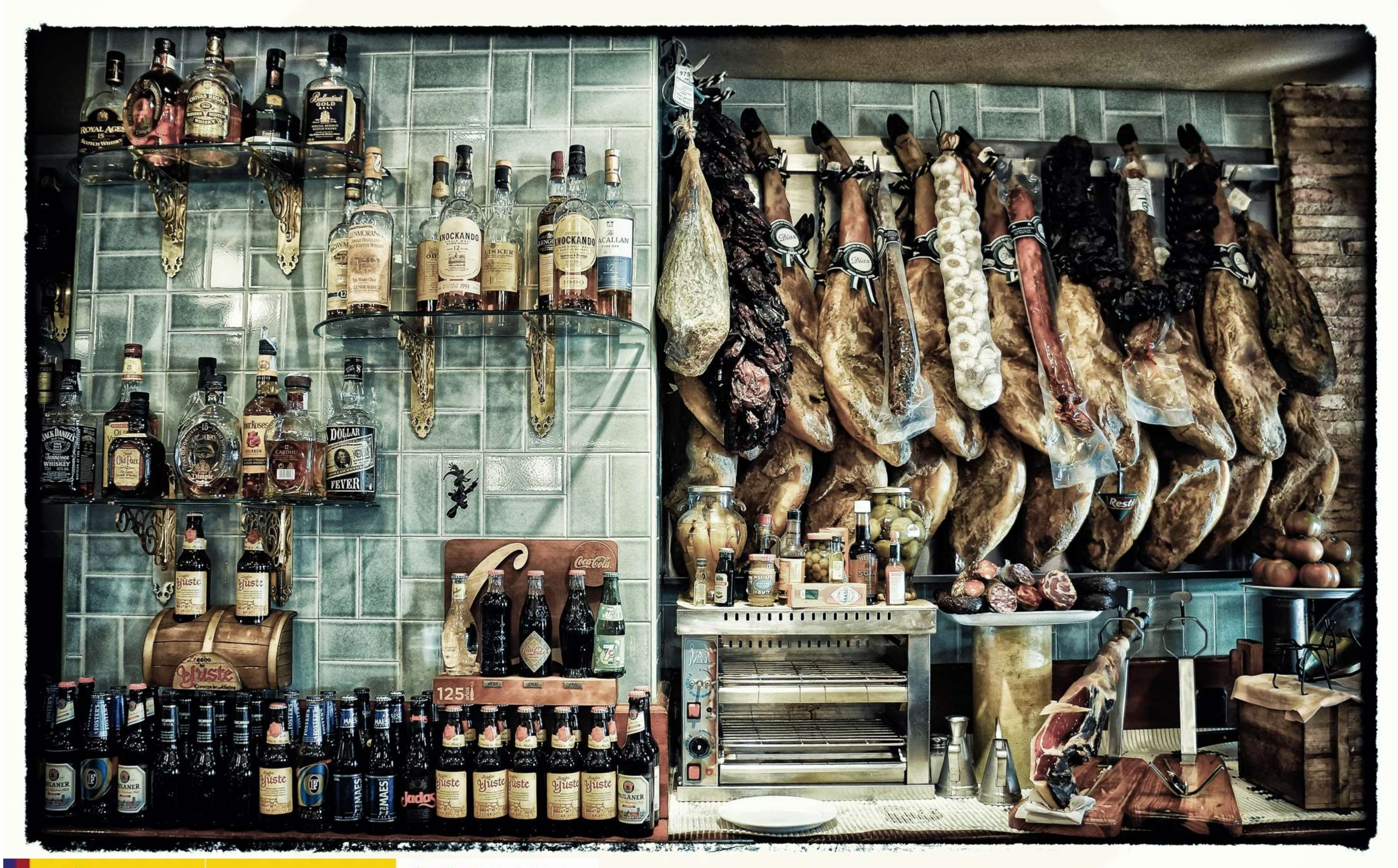
6. Stakeholders and expectations

How to reach them:

- Direct contact, internet, (online) workshops, questionnaires

Thanks!



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