REFLOW

"Phosphorus REcovery for FertiLisers frOm dairy processing Waste"

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Deliverable D3.10

Report on consumer and retailer behavior-food purchasing

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Contents

Abstract

This document contains a report on Consumer behaviour for food products from the EU Marie Skłodowska-Curie action funded Early Stage Researcher (ESR13) active in Work Package 3 of the REFLOW European Training Network.

This deliverable consists of a literature review on consumer acceptance and behavior of food products. Several scientific-based documents on consumer behavior of different food products were reviewed. Among the most relevant findings from this literature exploration is the fact that consumers construct a preference based on several attributes. The overall evaluation of the product's attributes is translated into purchasing behavior.

It was observed that environmental impacts are important in the selection of food products, especially among informed sectors, however this is not considered as one of the most relevant criteria. Nevertheless, the literature suggests that there is a positive trend for the acceptance and Willingness to Pay for sustainable food products which gives a indication of the market potential and success of REFLOW products.

In addition, a literature review was conducted for retail companies of food products. Some authors have already identified drivers and barriers for the adoption of sustainability marketing and strategies; however, it was found that it strongly depends on their commitment to sustainability based on their client's preferences. Based on that, the future activities for this research have been refined.

Introduction

General background

Food consumption patterns are rapidly changing due to a concern and increasing awareness regarding the environment, nutritional value and health issues, primarily (Tsakiridou et. al, 2008). While agricultural productivity has demonstrated significant achievements in terms of productivity, several authors have continuously agreed that significant environmental impacts from industrialized agricultural production have resulted in a significant threat to natural resources arising from intensive water use, soil degradation, climate change, natural resources depletion, pesticides use, among others [1,20,21].

To a major extent, the success of the expansion of the agricultural industry globally has relied on mineral fertilizers. While fertilizers have certainly played a key role in high crop yields the downstream impact of the same nutrients degrade environmental quality and human well-being [32]. A potential threat to food security globally is due to the consequences of the use of mineral fertilizers, particularly via leakage of Phosphorus (P) and Nitrogen (N) into the natural environment in the form of nitrates, ammonia, and phosphates (NH_3, NH_4, and PO_4).

The consequences of the industrialization of agriculture impact upon an extremely complex system and any response needs to take account of the increasing demand for food with a strict alignment with sustainable practices[23]. With the recognition of adequate environmental management, food production systems are constantly changing with the aim of reducing their environmental impact, but also trying to satisfy the needs of the population with better quality products.

Future improvements in agriculture will entail a shift in the market dynamics of the traditional (ex. mineral) fertilizer sector. Alternative bio-based fertilizers that specifically exploit waste management technologies for nutrient recovery is expanding. Nevertheless, there is a knowledge gap in terms of the attitude, knowledge, adoption, and role of stakeholders regarding the market adoption for these novel products [30,14]. An understanding of the acceptance of bio-based fertilizers, will facilitate the development, production, and marketing of innovative alternatives across the entire value chain. [37,23,11,13]. In addition, is also important for policymakers as regulations need to be included in any policy agendas.

Context and study case

In the European Union (EU), the agricultural sector accounted for 1.1% of the total GDP in 2018. In that context, the dairy industry is the biggest sector with 13.2% followed by vegetables and horticultural plants with 13% with an average cumulative growth of 0.8% p.a.[7,8].

Recently, several sustainability initiatives, projects and regulations have been initiated by the EU to diminish the environmental impact and ensure a sustainable future for

agriculture. As a result, and based on the concept of a circular economy, a potential improvement over the use of chemical fertilizers is the recuperation of phosphorus from P-rich effluents from the dairy industry.

In this context, REFLOW proposes an interdisciplinary cross-sectoral European Training Network merging world-leading scientists and key stakeholders in dairy processing, fertilizer production, and phosphorus recycling. The main REFLOW objective is to address important technical and socio-economic challenges associated with the recovery of phosphorus from dairy processing wastewater and its recycling into fertilizer products enabling sustainable expansion of the dairy industry in Europe.

The overall research goals of REFLOW are to develop and demonstrate processes for the recovery and reuse of phosphorus products from dairy processing waste (DPW), to establish their fertilizer value and optimum application rates, validated through field trials and to address the environmental, social, food safety and economical challenges, ultimately finding market-driven solutions for the new processes and fertilizer products. [36]

This research work uses REFLOW processes as a case of study for the development of market models for vertical integration of value along the stakeholders' chain with a deep exploration of motivations, priorities their requirements. Outcomes are intended to reveal which REFLOW products are more acceptable to the market and how value can be sustainably distributed along the entire value chain.

Consumers acceptance of final food products

According to Grunert et. al (2011), when dealing with new product development, the use of consumer insight techniques has benefits such as the identification of market opportunities, technology acceptability, optimization of product concepts, related communication and prototype test before launch. Hence, the first important step in the investigation of consumer attitudes.

"An attitude is defined as the evaluation of an object" [25] cited by [32]. Within a vast number of products, consumers are required to make purchase decisions daily. The reason for choosing a particular product (ex. fertilizer, food, etc.) merely depends on the attitude (positive or negative) towards the product; and attitude relies on a large number of product characteristics. This combination of different product attributes and consequences inform the general evaluation of the product which leads to product choice. [32,25]

Nguyen Hoang Diem (2018) performed research on organic labeled food products in Vietnam. The author stated that when referring to consumer's attitudes and behaviors, three main components can be identified: i) cognitive factors, ii) affective factors and iii) conative behavioral factors. The first classification is related to the consumer's awareness of the product (ex. knowledge, thoughts, beliefs and perceptions). The second classification is referred to the emotional attachment (positive or negative) towards a product and thirdly, conative factors refer to the tendency to perform a behavior (ex. intention

purchase, Willingness to Pay (WTP), purchase behavior). Cognitive factors determine affective and conative factors in a decision-making context [16,10,19]. An adaptation to the conceptual diagram described by [19] can be seen in Figure 1 presented below:
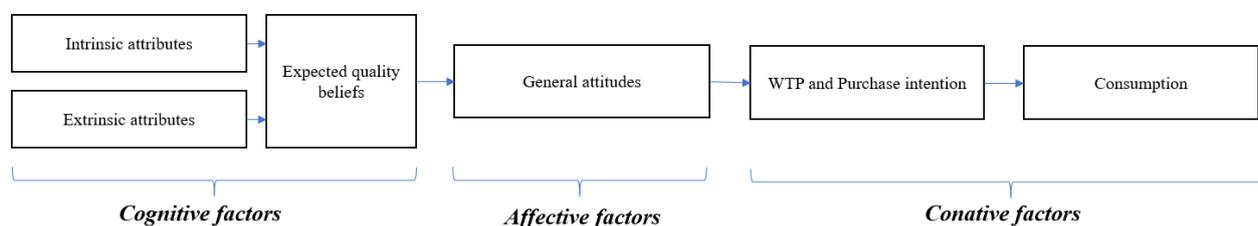

Figure 1. A conceptual framework for consumer attitude and behavior towards food quality labels. Adapted from [19]

The construction of a general attitude (WTP for final products/consumption), has its origins in intrinsic and extrinsic quality indicators. The experiments conducted by [19] on rice and vegetables exposed a positive relation of both intrinsic and extrinsic indicators of purchase intentions for safe products. This implies that consumers who have higher perceived importance of these attributes have higher purchasing intentions. However, the purchase intention coefficients between intrinsic and extrinsic indicators have a remarkable difference between them. This means that the influence of intrinsic indicators over final consumption is higher than the extrinsic attributes.

The individual factor loadings for intrinsic attributes in order of magnitude are numbered as follows. 1) Safety, 2) Quality, 3) Health Value and Trustworthiness, respectively for rice and vegetables. Whereas individual factor loadings for extrinsic attributes scored 1) Package and 2) Product label. This gives a reference for the implication of the importance of intrinsic attributes over final purchasing intentions. Nevertheless, several subcategories can be identified from each of the attributes as part of the evaluation of a product. The results from the evaluation can be seen in Figure 2 presented below.

	Purchase intention towards high quality rice (n=496)			Purchase intention towards safe vegetables (n=493)		
	Coefficient	SE	p-value	Coefficient	SE	p-value
Intrinsic attributes	0.90	0.15	<0.001	0.86	0.18	<0.001
Extrinsic attributes	0.22	0.10	0.035	0.75	0.13	<0.001

SE: Standard Error; Model for high quality rice: X^2= 41.571, df = 24, X^2/df= 1.73, p= 0.014, RMSEA= 0.038, SRMR= 0.025, CFI= 0.995, TLI= 0.992, CD= 0.993. Model for safe vegetables: X^2= 22.271, df= 24, X^2/df= 0.93, p= 0.563, RMSEA< 0.001, SRMR= 0.014, CFI= 1.000, TLI= 1.000, CD= 0.966.

Figure 2. A standardized solution of structural equation models for high-quality rice and safe vegetables [19]

It was observed that food safety and health value (intrinsic) are one of the most important attributes for the evaluation of food products. Food safety encompasses food handling behaviors to all consumers and food handlers (cleanness, raw-cooked separation, safe water, and raw materials, etc.) to prevent foodborne diseases. Healthy food refers to the

dietary intake that protects to malnutrition and diseases that lead to global health risks. [33,34]

Both definitions are mutually inclusive and match with the findings from other scholars. [13,15]. Additionally, trustworthiness and quality are part of the intrinsic category. Quality attributes refer to appearance, texture and food flavor, whereas trustworthiness refers to anonymous production, publicity levels, transparency, and traceability[18,19]. These four factors are the most significant intrinsic attributes as mentioned by several authors. A categorisation of intrinsic attributes and their subcategories can be seen in
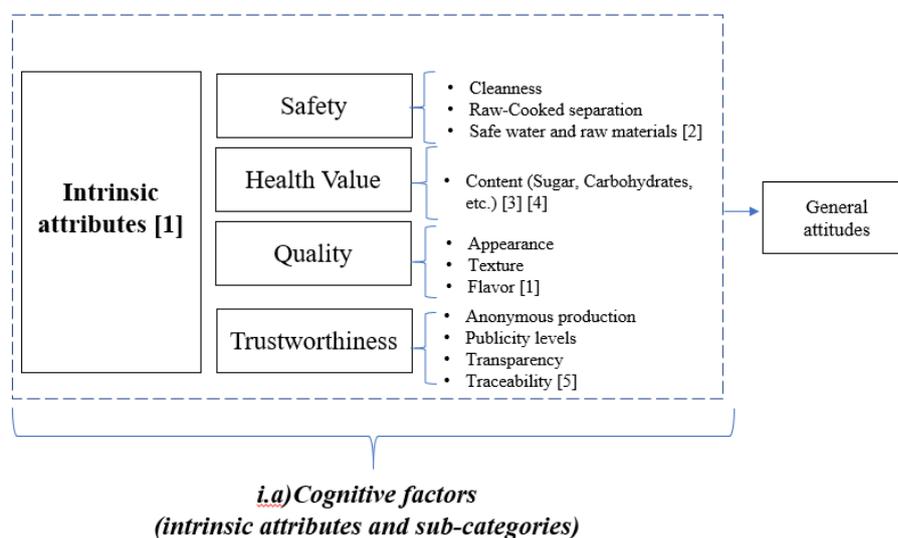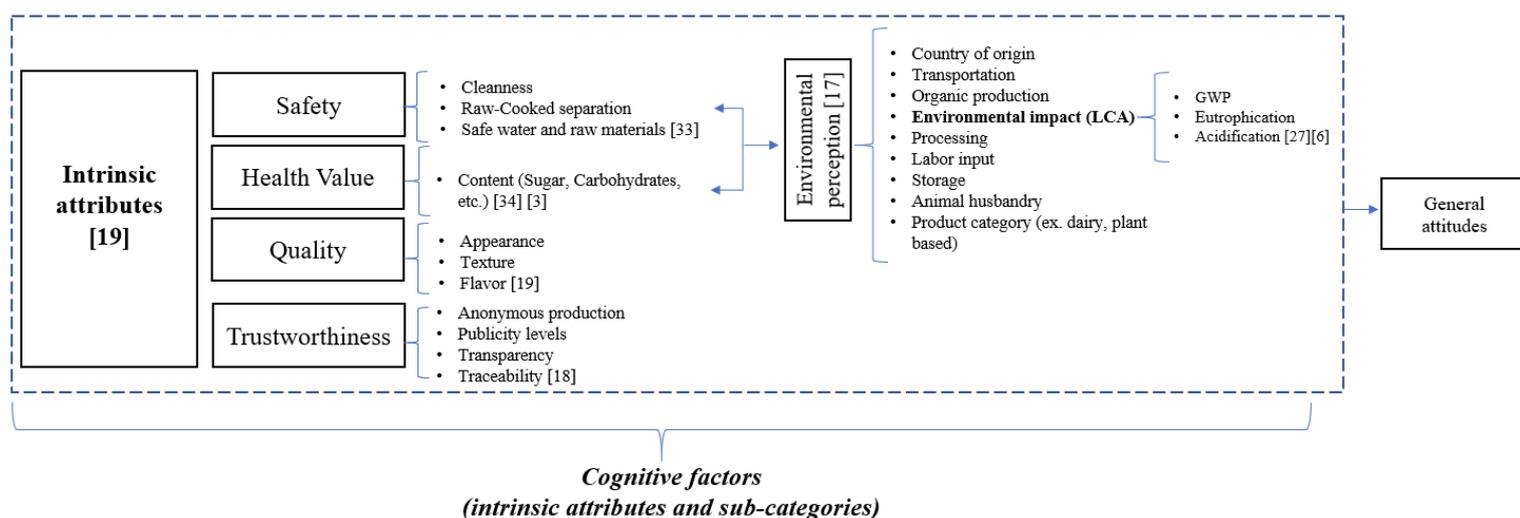
Figure 3 presented below:

i.a) Cognitive factors
(intrinsic attributes and sub-categories)

Figure 3. Intrinsic attributes and subcategory.

The allocation of environmental attributes to final consumer decisions might also play a role. Until now, none of the scholars cited identifies the category "Environment" as criteria for food product evaluation. The next section explains how the environment relates to intrinsic attributes and the degree of importance regarding final food product consumption.

Environment and health perceptions on final product acceptance

Consumers commonly associate environmental friendliness with healthiness. To prove that, Lazzarini, et al.[17] conducted a study on consumer's perception healthiness and environmental friendliness of 30 different protein products on Swiss consumers. They found that these 2 variables are significantly correlated with life cycle assessments (LCA) and nutrient profiles, respectively. This is to say, that there is a direct relation between, environmental impact and perceived healthiness of food products merely based on common consumers.

Accordingly, both health and environmental food perceptions can be used in synergy. Environmental performance of food products can be included as a subcategory of intrinsic indication of purchasing behavior documented by Nguyen Hoang Diem[19] for either safety or healthy food. In the same research Lazzarini et al.[17], described the most mentioned criteria as predictors for both perceived healthy (Origin, organic, production, digestibility, nutrient content, etc.) and environmental friendliness (transportation, environmental impact, processing, labor input, etc.). In total, 9 factors make up environmental impact according to consumer's perceptions. Fertilizer use, and particularly phosphorus, can be included as a subcategory of environmental impact for eutrophication, according to Life

Cognitive factors
(intrinsic attributes and sub-categories)

Cycle Assessment methodologies**.** The final identification of intrinsic attributes and perceptions can be seen in Figure 4 presented below.

Figure 4. Intrinsic attributes and subcategories.

A general overview of consumer's motivations and priorities

By providing literature insights into consumer acceptance and food purchasing behavior for several food products, a global picture of the process was presented. It was also found that the process is composed of several subcategories and that environment indeed, can be specifically associated with food quality and health aspects.

Grunert et al.[9], performed a study regarding quality perception and acceptance of dairy products by evaluating factors such as hedonic, health-related, convenience and quality aspects. The authors of this study stated that even while consumers may be motivated to

process information (to lead acceptance/rejection of a food product), many do not possess the ability to process the information of the benifis of a given product. An example might be the production of a certain product with "waste-based fertilizers with a circular economy approach" because they do not have necessarily specific environmental knowledge.

This research suggests that if there are no specific psychological or health claims, there is little interest in final purchase intention for the enrichment/process modification and is unlikely to be translated into purchasing behavior. Thus, environmental attributes should be addressed in terms of food health and safety rather than solely environmental benefits.

Nevertheless, a study conducted by De Graaf et al.[5] analyzed market opportunities for better sustainability practices of milk production and consumption, focusing specifically on animal-friendly milk in different consumer segments. The authors emphasized that consumers have an increasing, but highly variable interest in sustainability attributes. This was also identified by Van Loo et al.[14], who found that values differ significantly among countries, products and socio-demographic groups, as well on publicity (i.e. EU organic logo). According to Kutnohorska[15], one of the main challenges for the adoption of organic food throughout the market is still it's a very high price, limited availability, lack of trust and perceived value.

Despite the challenges mentioned by Kutnohorska[15], Shafie[25] highlighted the opportunity of sustainable food products (i.e Organic label) since the results from this study found that participants are willing to pay (WTP) approximately a 10% premium for organic food with an average gender segmentation of 9.5% by women and 11.4% by men. Van Loo et al.[14] conducted a study of consumer attitudes, knowledge and consumption of organic yogurt. Among their findings is that the WTP for organic yogurt ranged from 15% for non-buyers to 40% extra for habitual buyers. Also, the VLAM [32] cited by Van Loo et al.[14] observed a WTP from 55 to 64% extra for organic compared with conventional milk.

Up to now, general studies of final consumers of food products are described. A second step for this report is the analysis of the perspection and trends of food retailers as a key element between production and final consumption. The following section describes what are the attitudes and drivers identified by scholars referring to food product retailers and their attitude regarding the adoption of sustainability practices.

Retailers on sustainability actions

As a key stakeholder between the production, distribution, and consumption of food products food product retailers (i.e. distributors, supermarkets, etc.) play an essential role. Retailers source products (i.e groceries, clothing, etc.) through various distribution channels to provide goods for consumers to generate profit.

An impotant opportunity to incorporate and promote sustainability campaigns is identified within the retailer sector. To that extent, efforts to address issues of agricultural concern in Europe have played a previous role before at retailer level. EUREPGAP, established in

1996 (an integration of a group of 13 large European retailers). EUREPGAP was meant to establish sector-oriented protocols of standards for good agricultural practices (GAP). Initially this included horticultural practices.

This a clear example of an alliance between retailer actors which has been active for at least 20 years in which fertilizer regulations can be embedded. From this point of view, several initiatives and a number of retailer companies have developed their sustainability strategies, however, along the way they have encountered several difficulties and opportunities that have been documented by scholars.

This section of this report analyzes primarily two scientific publications. Firstly, Chkanikova and Mont[4] which conducted a literature review of academic publications and reports as well as personal communications with a diverse range of people within retailer firms (i.e managers, etc.) to determine the factors that affect the willingness and ability of food retailers to launch sustainable supply chain initiatives. And secondly, Belz and Schimidt-Riediger[2], who investigated characteristics and drivers of sustainability strategies in the retailer industry.

As cited by Chkanikova and Mont[4], Hoffman[12] identified four major categories that play a role in shaping the sustainability agendas in the retail industry: regulatory, resource market, and social forces. Based on that classification, Chkanikova and Mont[4] documented the main drivers and barriers based on the retailer's experiences (i.e personal communications) and several other authors.

A summary of the main findings on the barriers/drivers to adopting sustainability initiatives can be seen in Table 1 below:

Category	Drivers	Barriers
Market factors (customers, competitors, industrial association, service provider pressure)	-Consumer demand for greener and healthier food (opportunity though green product differentiation) -Industrial norms (voluntary industry agreements and certification schemes) -Sustainability awards from third party organizations	-Globalization and the search for cheap/junk food (difficulties to monitor sustainability improvements in supply chains) -Geographic dispersion of suppliers where insufficient government enforcement is achieved -Product quality attributes from more sustainable production do not justify higher supply chain costs -The proliferation of eco-labels leading to consumers confusion and inability to recognize quality goods
Resource factors (shareholders, suppliers, and investors)	-Demands for an increase of financial returns by cutting operational costs from stakeholders -Increased investors appeal because of sustainability -Possibility to the strong brand name, thus competitive advantage	-Cost measures. Retailers tend to address sustainability aspects that require lower investments and economic savings -Lack of expertise for developing and implementing sustainability strategies upstream in the food supply chain (i.e no influence of the environmental performance of own-brand suppliers -Costly collaborative relationships with suppliers

		-Lack of power to influence suppliers
Regulatory factors	-Pressure from governments in the form of regulations -International regulations (UN declarations SDG, EU action programs, etc.) -Anticipated actions of future regulations	-Lack of leadership and support of governments Lack of harmonization of regulations between countries -Too costly and/or strict legislation
Social factors (society, NGO, media, academia, etc.)	-The emergence of consumers who view shopping choices as an exercise of ethics and moral responsibility -Critical consumer pressure to address sustainability issues -Sustainability issues drawing the attention of environmental advocacy groups (i.e Greenpeace, WWF.) -Negative publicity in media via documentaries and films addressing sustainability -Fear to face court due to socially irresponsible behavior (i.e unfair, exploitive, abusive labor)	-Low interest and awareness of sustainability issues from consumers -Concern among the public on whether sustainability is a constructed phenomenon rather than a reality -Lack of scientific evidence and an agreed methodology to balance various environmental and social aspects making difficult for retailers to engage

Table 1. Market factors, drivers and barriers for sustainability agendas in-retailer firms[1].

Generally speaking Chkanikova and Mont[4] concluded that there is a window of opportunity to investigate the relative importance of barriers and drivers for sustainable supply chains initiatives, for which a high degree of homogeneity can be found based on the types of retail organizations and the types of business models and how they target their marketing strategies.

Belz and Schimidt-Riediger[2], stated that certain target groups and the positioning of products are strategic decisions for sustainability marketing. The authors identified three major consumer segments within which companies target their marketing strategies. A classification for retailers was performed as a function of their target group. The classification of consumer segments can be seen in Table 2 below.

Consumer type	Characteristics
Socio-ecological actives (1)	Small group and represent the innovator consumers of sustainable products
Socio-ecological approachable (2)	WTP more, but reluctant to compromise when it comes to the quality of the product.
Socio-ecological passives (3)	Not particularly conscious about social and ecological issues. This group does not perceive socio-environmental features as value-added.

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[1] A complete bibliography can be found on Chkanikova [4].

Table 2. Consumer type and characteristics based on socio-environmental positions. Adapted from Belz and Schimidt-Riediger [2]

As well as being a function of consumer types, retailer companies provide goods to specific markets.

Table 3, summarizes the classification retailer segments types and their characteristics according to their consumer target based on their position regarding socio-environmental aspects.

Retailer type	Characteristics	Consumer target
Performers	Offer products of a very high social and ecological quality addressing the whole product lifecycle. They charge premium prices, commonly through small distribution channels.	(1)
Followers	Offer products of a very high social and ecological quality but less than performers.	(1)(2)
Indecisive	Low social product quality and medium product quality. and not seem to pursue distinct strategies.	(2)
Passives	Process food products with a medium to low social-ecological quality. Lower prices and distribution via conventional food retail chains (mostly larger companies are on this segment. i.e wholesale.)	(3)

Table 3.Retailer type and consumer target Adapted from Belz and Schimidt-Riediger (2010)

Based on the consumers and retailer types described above, it make sense that companies target specific market segments, but as Chkanikova[4] mentioned, several factors for barriers and drivers can be identified within the retailer groups. Belz and Schimidt-Riediger[2] investigated the characteristics to determine "whom influences whom to adopt sustainability practices?" This research encompassed the formulation of multiple hypotheses to examine the relative importance of each factor via binary logistic regression analysis. The theoretical framework was aimed at determining which of 7 different factors (consumers, retailers, competitors, legislators, top management/owners, public exposure and industry membership) had the higher pursuit of sustainability marketing strategies in the German food market according to their socio-ecological position (performers, followers, etc.).

The main findings indicated that the inclusion of social-environmental marketing depends not only on the industry sector but also in the market segment within which company is competing.In addition, depending on the market segments, the stakeholders influence differently. The correlations performed by Belz and Schimidt-Riediger[2] showed that the performer's segment significantly perceives pressure from consumers, while indecisive and passives displayed the opposite by perceiving less influence in their commitment to sustainability marketing. Some other effects were discussed such as no perceived influence by retailers and competitors. Regarding legislation, the performer's group correlated positively while the indecisive do not feel pressure from legislators to enhance sustainability marketing. This suggests a good approach is the definition of "real" actors to determine their positions, views, etc. and then determine what is likely to promote their action towards sustainability based on their business strategies with a strong focus on the dairy industry sector.

Gaps in knowledge and future REFLOW steps

As a global remark for this research, the literature review has shown that consumer acceptance is composed of several evaluation factors. It is important to address each factor separately to increase the awareness of a product that translates into purchasing behavior. Certainly, the environmental friendliness of a product correlates positively with healthy products and scholars have shown that there is a predisposition to pay more for more sustainable food products. Nevertheless, this influence might be biased given that some environmental attributes can be more ethically tangible than others, such as animal husbandry[5].

These references are a clear indication of the potential market for the adoption of sustainability practices directly on food products. Special attention should be taken when pricing products, market penetration (availability) and the definition of an adequate communication strategy for branding, in order to increase trust and perceived value. Most importantly, ensure intrinsic attributes such as taste via sensorial analysis, maintenance of quality levels of food products and the communication of associated health benefits as well of environmental impacts. These statements suggest therefore that the measures to enhance sustainability in food products should be coordinated at various stakeholder levels across the chain, by instance retailer industries.

As mentioned before, retailers are a key piece on delivering sustainability and changing patterns of food consumption. Nevertheless, their level of commitment to sustainability strongly differs based on their market target. As well, firms that are willing to adopt sustainability measures can encounter several barriers to implementing their strategies, but also windows of opportunity.

The first set of activities to understand acceptance, needs and requirements of REFLOW products should be focused on defining the following:

What are the products that can be potentially produced with REFLOW products? In doing so:

1) *Which dairy industries will be part of the study?*
2) *What is their commitment level to sustainability, what to they need to achieve their sustainability targets, as well what are their main barriers and opportunities to be addressed?*
3) *Which (retailers) distribute final food products to consumers and what is their role in term of sustainability (i.e. performers, followers, etc.)? What are their specific main barriers and opportunities for the dairy industry sector?*

This information will be useful to identify firstly, the main consumer target/segment that can be potentially acquiring final food products. In doing so, determining *-or researching-* what are the maximum prices that the consumer segments are willing to pay for a product with such attributes (i.e. dairy products produced with REFLOW products). It is also

important to identify the communication strategy that should be addressed and the interventions to be made to synchronize both consumer's needs, but also retailers' priorities. This literature review encompassed the documentation of findings from a broad perspective. Most of the studies here described applying the sustainability concept in a general term. A must for the project is to focus on further activities specifically in the context of the dairy industry sector.

Before the execution of these activities, it is worth expanding the general overview to the rest of the stakeholder's chain (i.e. dairy factories, farmers, etc.) to understand their priorities, drivers, and barriers as well on the adoption of sustainability measures specifically during the production phase. The big picture of the process will determine the order on which activities should be done for the completion of this research.

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