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ID+ RESEARCH INSTITUTE FOR DESIGN, MEDIA AND CULTURE

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DESIGN COMMIT
1ST INTERNATIONAL CONFERENCE ON DESIGN & INDUSTRY 2024
BOOK OF PROCEEDINGS

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DESIGN COMMIT

1ST INTERNATIONAL CONFERENCE
ON DESIGN & INDUSTRY • 2024

BOOK OF PROCEEDINGS

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BOOK OF PROCEEDINGS FOR THE DESIGN COMMIT 2024 CONFERENCE

INTRODUCTION

This Book of Proceedings is a collective endeavor and an academic commitment from the participants of the Design Commit 2024 Conference. All papers have undergone a meticulous peer-review process, orchestrated by our Scientific Committee and executed under strict guidelines of anonymity and impartiality. Our goal is to present a compilation of research that not only reflects innovation and diversity in the field of design and industry but also fosters constructive dialogue on sustainable futures and social responsibility within these realms.

SUBMISSION AND REVIEW PROCESS

Each submitted manuscript underwent an initial review to ensure relevance to the conference theme and adherence to established guidelines. The subsequent double-blind peer review was employed to safeguard the integrity of both reviewers and authors, supporting fair and unbiased judgment. We recognize the importance of authentic academic discourse and as such, are dedicated to a zero-tolerance policy on plagiarism and a commitment to originality.

EDITORIAL ETHICS AND CONTENT USAGE

This book is a copyright-protected work, with all rights reserved. Any use of the content herein, outside the scope of private study, research, criticism, or review, requires explicit authorization from copyright holders. We underscore the importance of ethics in academic information usage and encourage practices that promote scientific integrity and collaboration.

CONTRIBUTIONS AND AUTHORSHIP

We clearly outline the responsibilities of authors, from initial submission to the presentation process. Contributions should reflect the work of no more than five collaborators, with the designation of the corresponding author established to facilitate communication and ensure accountability. We emphasize the value of transparency and the proactive declaration of any potential conflicts of interest.

COMMITMENT OF REVIEWERS AND COMMITTEES

Both the members of the Scientific Committee and reviewers are integral parts of this process, committed to maintaining the academic rigor and excellence that are the hallmark of Design Commit. They are dedicated to thoughtful evaluations, enhancements of submissions, and the efficacy of academic communication.

CONCLUSION

The DESIGN COMMIT 2024 Secretariat wishes to express gratitude to all contributors, whose works comprise this volume. May the papers presented here serve as catalysts for ongoing innovation and inspiration for all those committed to the advancement of design and industry.

DESIGN COMMIT
1ST INTERNATIONAL CONFERENCE
ON DESIGN & INDUSTRY 2024

DESIGN COMMIT conference is an event organized by the **Lisbon School of Architecture** (FA ULisboa), in partnership with the **School of Design** (ESD) of the **Polytechnic Institute of Cávado and Ave** (IPCA), the **Department of Communication and Art of the University of Aveiro** and the **OIKOS research group** of the **Research Institute for Design, Media and Culture** (ID+), the **School of Applied Arts** (ESART) of the **Polytechnic University of Castelo Branco** (IPCB), and **Rethink – Research Group on Design for the Territory** (CIAUD); and **School of Architecture, Art and Design of the University of Minho** (EAAD) and the **Design and Technology Group** (DeTech) of the **Laboratory of Landscape, Heritage and Territory** (Lab2PT).

The conference operates under the scope of the **Research & Education in Design research group** (REDES) from the **Research Centre for Architecture, Urbanism and Design** (CIAUD).

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ABOUT US

The first edition will be an in-person international event, consisting of a wide variety of plenary sessions, and bringing together researchers, academics, designers, rapidly expanding technology companies, emerging companies, business associations and policy makers, with the objective of fostering and actively developing a joint reflection, in a transdisciplinary scientific exchange, which enhances innovation through Design and Industry for a better future with a strategic vision.

Fields that will stimulate responses to the challenges of climate change and environmental degradation will be proposed, paving the way to achieve the goals of the 2030 agendas.

The DESIGN COMMIT 2024 will take place during the 7th Braga Economics Week, an initiative promoted by InvestBraga, aimed at addressing economic issues, involving various types of events, and promoting the exchange of ideas among economic agents, institutions, and citizens.

PURPOSE

This international conference aims to explore models that prioritize a post-growth economy, with **modern**, **resource efficient**, **smart**, **sustainable** and **inclusive** principles, focused on enhancing human health and education, promoting knowledge and inter-sector collaboration, and a digital society for all. And, in this way, contribute to the transition towards a more sustainable, equitable, and resilient future that considers the well-being of both people and the planet.

Amid pandemics, wars and environmental disasters, designers and industries have been forced to imagine a world in which the only way to move forward is to look back. Design and Industry need to understand the role they can play in removing obstacles to social progress and work together to create healthier societies.

PREFACE TO THE DESIGN COMMIT 2024 CONFERENCE

A Word from the Conference Chairs

Dear participants and collaborators,

It is with immense pleasure and honor that, on behalf of all the chairs of Design Commit 2024, we welcome you to this unique event, dedicated to the fusion of design and industry and their vital role in shaping a resilient and sustainable future.

In a world of constant transformation, where sustainability and innovation have become imperatives, Design Commit emerges as a beacon of knowledge and collaboration. Our mission is to unite thinkers, creators, educators, and industry leaders to discuss, share, and promote practices that lead to excellence and responsible innovation.

This year's conference presents an exceptional program, filled with inspiring keynotes and discussion panels that promise to stimulate critical thinking and the exchange of ideas. Each session has been carefully planned to reflect the challenges and opportunities presented to our global community.

Through this Book of Proceedings, we offer a glimpse of the innovative research and studies that will be showcased. The papers reflect the depth and diversity of the participants' contributions and serve as a window into the future directions of design and industry.

We wish to express our profound thanks to the members of the Scientific Committee, the organizing team, and everyone who contributed to making Design Commit 2024 possible. Your tireless commitment to excellence and the exchange of knowledge is the driving force behind the success of this event.

We invite you to delve into the following pages and join us on the journey of learning and discovery that we promote. May the discussions and insights generated here inspire actions and innovations that transcend the boundaries of this meeting.

With high expectations and a sense of enthusiastic anticipation, we move forward together to explore the boundless potential of design and industry in creating a more promising future for all.

Warm regards,

The Chairs of Design Commit 2024

MARIA JOÃO FÉLIX, FÁTIMA POMBO, FERNANDO MOREIRA DA SILVA, PAULO CRUZ, RITA ASSOREIRA ALMENDRA

OVERVIEW AND OBJECTIVES OF THE DESIGN COMMIT CONFERENCE

OVERVIEW

Design Commit stands at the forefront of interdisciplinary dialogue, bringing together innovators, visionaries, and thought leaders from the realms of design and industry. As we gather in the bustling heart of creativity, our agenda is driven by the challenges and possibilities of integrating sustainable practices within these dynamic fields.

At the core of Design Commit is the dedication to fostering a community where collaboration transcends traditional boundaries, encouraging a synergy that fuels transformation and growth. We convene under the shared belief that design is not just an aesthetic choice but a pivotal tool for societal and industrial evolution.

OBJECTIVES

- **To Inspire Innovation:** By showcasing cutting-edge research and case studies, we aim to spark new ideas that participants can take back to their own work, driving the frontiers of design and industry forward.

- **To Facilitate Networking:** Providing a platform for professionals from various sectors to connect, share insights, and forge partnerships that have the power to reshape the market landscape.

- **To Educate:** Through keynotes and panel discussions, we offer learning opportunities that enhance skills, expand knowledge, and offer new perspectives on tackling the design and industry challenges of today and tomorrow.

- **To Promote Sustainability:** Emphasizing the importance of eco-friendly and socially responsible design, we encourage discussions and solutions that contribute to a sustainable future.

- **To Advance Research:** Encouraging the exchange of academic findings and engaging with the latest in scholarly work, thus nurturing a space where theory meets practical application.

- **To Advocate for Change:** Pushing the boundaries of what's possible, and advocating for a proactive stance on global issues through the lens of design and industrial development.

As we embark on this journey of discovery and innovation, the Design Commit Conference is more than just an event, it is a catalyst for change, driving a future where design and industry not only coexist but thrive together, fostering an ecosystem of sustainable development and progressive thought.

ACKNOWLEDGMENTS TO SPONSORS, COLLABORATORS, AND SUPPORTING INSTITUTIONS

The realization of the Design Commit 2024 Conference was made possible through the generous support and commitment of our sponsors, collaborators, and supporting institutions. At this moment of gratitude, we would like to express our recognition to everyone who contributed to the success of this event.

To our sponsors, whose financial and in-kind support has strengthened the structure and quality of the conference, we offer our heartfelt thanks. Your vision and understanding of the value of innovation in design and industry are fundamental to our collective progress.

We are immensely grateful to the organizing team, who shared their expertise and passion, enriching the program with insightful talks and discussion panels. Your dedication to excellence and professional development has not gone unnoticed.

A special thank you goes to the supporting institutions, whose partnership and support were essential to expanding the reach and depth of our meeting. Your collaboration allows the ideas discussed here to resonate beyond the conference walls.

We also acknowledge the assistance of various entities and volunteers, whose help behind the scenes was vital for the logistics and organization of the event. Your hard work and attention to detail ensured a smooth and memorable experience for all attendees.

Last but not least, we thank the academic and research institutions that, by supporting their representatives and researchers to participate in Design Commit, underscore the importance of an ongoing commitment to learning and innovation.

Together, we have built a conference that reflects the intersection between creativity, technology, and business, paving the way for the future of design and industry. Our sincere thanks to all of you for being part of this journey.

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APPL(E)AUSE. A FOOD DESIGN EXPERIMENT TO CREATE NEW PROCESSED FOODS FROM APPLE BY-PRODUCTS

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The work addresses the challenges associated with the sustainable management of food resources through the application of knowledge from the discipline of Design. The aim of the research is to identify new scenarios to increase the competitiveness of the Piedmontese agro-industry sector by identifying new uses for the by-products of fruit processing. The work focuses on using apple pomace in the development of new edible products, enhancing local food resources, and proposing new uses for a by-product that is currently destined for disposal. By adopting a transdisciplinary and design-led approach, it was possible co-design new edible processed foods, involving different territorial actors. The first collected results showed the possibility of valorising apple pomace and reintroducing it into the food cycle, adopting a circular economy for food approach.

Keywords: Food Design, Design With Food, Transdisciplinary Approach, Apple Pomace, Circular Economy.

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1. Introduction. Apples and Territory

Apple is the fourth most consumed fruit globally (Forsline et al., 2003), after oranges, bananas and grapes. According to the FAO (2023), European apple production increased from 14 million tons to more than 18 million tons between 1991 and 2021. Similarly, in Italy during the same period, apple production saw an uptick from 1.9 million tonnes to over 2.2 million tonnes, even as the cultivated area decreased from 77,554 to 54,470 hectares.

Piedmont is the second largest apple-producing region in Italy, following Trentino Alto Adige. Apples dominate the local cultivation, covering 7,090 hectares out of a total of 17,427 (Agrion, 2023), yielding over 1,500,000 quintals in 2019 (CREA, 2023).

Throughout the region, there are 4,507 companies specialised in the fruit sector (CREA, 2022), out of a total of 51,000, in which the predominant legal form is the individual company, accounting for 90.5% of cases (Regione Piemonte, 2010). In this context, diversification of agricultural activities is considered as a way of protecting and strengthening farm incomes against fluctuations in final product prices (CREA, 2022). In Piedmont, complementary activities account for 20.3% of the value of total agricultural production, which means that farms, especially small ones, carry out other activities such as fruit processing, direct sales and tourism in order to compensate for the high production costs and the low selling prices of the product to the wholesale market.

For instance, in the apple sector, the average production costs sustained by farmers are estimated to range between €0.40 and €0.47 per kilogram for the Gala variety in 2022 (Agrion, 2023). This is in contrast to a wholesale price of €0.43 per kilogram in 2022 and €0.83 per kilogram in 2023 (Ismea, 2023).

This data, in addition to underscoring a fluctuating price trend year after year, illuminates the imperative for small-scale producers to seek alternative forms of remuneration beyond purely cultivation. In this context, it is not uncommon to encounter small producers in the region who, in recent years, have diversified their activities into agro-industrial pursuits, such as the processing of apples into juices, jams, dried fruits, bakery products, and pastries.

In order to closely observe this emerging trend, a participant observation activity (Semi, 2010) was conducted in November 2023 at the *Tuttomele Fair* in Cavour (Turin), a national event dedicated to apples. Out of the 51 producers participating in the fair, 40 not only offered apples but also featured a diverse range of products. This included juices (37 producers), beverages such as cider and bitters (20), dried crisps (24), and infusions made from processed apples (8). Through interviews with 12 producers, the question was posed: *'Why do you produce additional products alongside apples?'* The responses consistently underscored the imperative to augment income, diversify the product portfolio, and counteract the escalating costs associated with apple production. While acknowledging that the survey is not exhaustive and is based on a limited sample of local producers, it illuminates the pressing need for small-scale producers to devise new strategies, enhancing the value proposition of their products to bolster competitiveness within the local fruit sector.

Our focus gravitated towards apple juice, identified as the most favoured product among consumers, constituting 65% of the total volume of processed apples (Kammerer et al., 2014). During the production process, nearly 75% of the apple's weight is extracted as juice, leaving behind fruit pomace—a fresh residue comprising skin, seeds, stalk, and pulp (Nadia et al., 2014). Presently, fruit pomace finds industrial applications in the production of pectins for the cosmetic and pharmaceutical sectors, while small-scale producers often address it to energy recovery or disposal. However, existing literature validates the nutritional benefits of this by-product. Consequently, a decision was made to delve deeper into potential applications in designing new processed foods. This strategic exploration could offer an alternative to disposal and potentially serve as an income source for local fruit growers.

1.1. The Apple Fruit Pomace. Uses and unexpressed potential

Today, fruit pomace is recognized in the literature as a potential functional and healthy component in the formulation of new edible products in the food industry (Lyu et al., 2020). However, only 15% of the pomace produced is currently used in industrial processes for pectin and citric acid extraction (Galanakis, 2020), production of purees and jams (Joshi et al., 1996) or in animal feed (Shalini & Gupta, 2010). When not repurposed through innovative production processes, the predominant method of disposal involves direct deposition into the ground. This conventional practice, however, poses a considerable environmental threat due to the elevated water content in the pomace and the substantial oxygen demand required for its degradation.

According to Shalini and Gupta (ibid), considering the large volume of this product, the identification of further commercial applications for fruit pomace could generate a large economic impact for the actors in the supply chain, increasing the added value of the product itself. In this sense, over the last two decades, the interest of research applied to industry has increased in order to promote the use of the pomace in the formulation of functional foods, rich in fibre, phenolic compounds and other nutrients (Lyu et al. 2020). Constituting approximately 30-25% of the weight of a fresh apple after the juice and nectar extraction process, apple pomace primarily comprises peel and pulp (95%), seeds (2-4%), and stalks (1%) (Perussello et al., 2017). The chemical composition of the pomace makes it a good source of antioxidants and dietary fibres (Rana et al., 2015).

These properties have promoted the testing of the formulation of new processed foods such as bread, dry pastries and alcoholic beverages. The results of the first researches point to the possibility of further developing research into the production of extracts and functional foods (Vidovic et al., 2020), since the use of pomace confers new properties to the products, such as: an improvement in the nutritional composition (Vasantha Rupasinghe et al., 2008), an increase in dietary fibres and other micronutrients (Cantero et al., 2022), a reduction in the use of chemical flavourings, because pomace releases a pleasant "fruity" flavour (Laukovà et al., 2016).

Apple pomace, and fruit pomace in a broader context, emerges as a by-product that currently presents challenges to the sustainable management of food resources, particularly within the local agro-industrial domain. This is especially pertinent in regional contexts such as that of Piedmont, where novel strategies are imperative to fortify the competitiveness of the fruit sector. The identification of novel applications for pomace, as an alternative to disposal or land spreading, emerges as a strategic approach to safeguard and augment the incomes of local farmers.

2. Methodology. Transdisciplinary and design-led approach

The research started in March 2023, involving the Polito Food Design Lab research group[1] of the Department of Architecture and Design of the Politecnico di Torino, in the context of the PNNR project Nodes - Digital and Sustainable North-West- which seeks to identify innovative strategies to enhance the competitiveness of the agroindustry sector in Piedmont. The primary objective was to develop edible prototypes, reaching Technology Readiness Level 3 (TRL 3), using food by-products. To achieve this goal, a structured methodology consisting of four phases was adopted: research, concept generation, prototyping, and testing and evaluation (Fig. 1).

[1] The Polito Food Design Lab is a laboratory that has been active since 2016. It engages in research, teaching, and third mission activities related to food-related themes such as food poverty, food sustainability, and the valorization of food surpluses. It collaborates and offers research and experimentation activities both within and outside the university, working together with researchers and professionals.

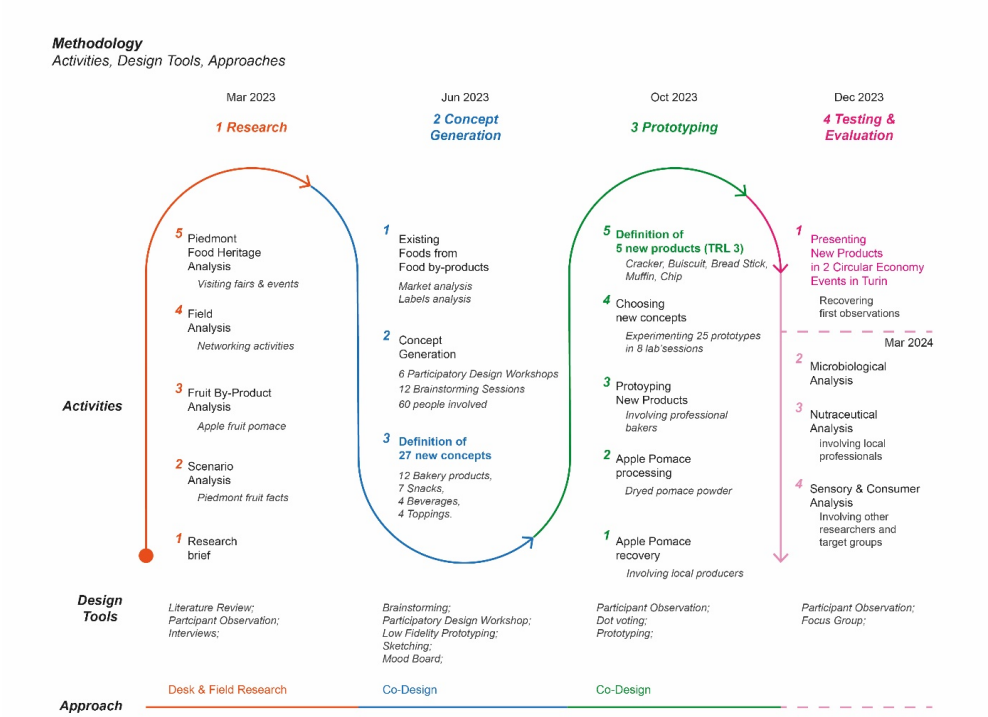

Fig. 1. Methodology. the four phases of the research process: desk & field research, concept generation, prototyping, testing and evaluation. **Source:** image by Authors.

2.1. Desk and Field Research. Phase 1

The aim of the research phase is to gain a better understanding of the current situation of the fruit sector in Piedmont and the potential of fruit processing by-products. During this phase, which encompassed both desk research (literature review) and field research (including visits to farmers and agricultural fairs, interviews with industry stakeholders), the apple emerged as the focal point of interest. This designation is attributed to substantial apple production volume in the region, the diverse array of existing varieties, challenges faced by local stakeholders in recent years due to heightened production costs and diminished market profitability, and the notable percentage of by-products that remain edible and recoverable from fruit processing (see Chapter 1).

2.2. Concept generation. Phase 2

In the second phase, the research team conducted concept generation sessions (Kumar, 2013) using participatory design workshops and brainstorming tools (Martin & Hanington, 2019). These sessions engaged university design students, along with young designers and other researchers. Led by the Polito Food Design Lab team, the sessions encompassed various activities, including pomace analysis, pomace transformation, sketching, concept writing, and prototyping. In total, 12 sessions have been conducted, involving 60 participants. The participants, organised into small working groups, leveraged their hard and soft skills to formulate new concepts and create preliminary, low-fidelity, and edible prototypes. The concept generation process resulted in the identification of 27 new concepts (TRL 2), each accompanied by a brief description outlining the product's characteristics, target audience, and the raw materials employed. Simultaneously, an equal number of preliminary edible models were developed. These

prototypes aimed to explore specific attributes such as shape, dimensions, colour, size, texture, and recipe formulation (Fig. 2).



Fig. 2. Concept Generation. Some shots of the concept generation phase. In the large picture a concept board of a new product, in the bottom row the apple fruit transformation, in the right column some finished prototypes. **Source:** image by Authors.

2.3. Prototyping. Phase 3

The aim of this phase is to increase the technology readiness level of the new concepts, involving professional expertise in food processing. Two key actors were involved in the prototyping stage: Cascina Danesa, an organic farm producing juices and ciders from which apple pomace was recovered; and Panacea Social Farm, a social cooperative that produces bakery products and has previous experience in re-using food by-products in the formulation of its bakery products. The prototyping phase unfolds in two stages: the production of dry pomace flour and the development of edible prototypes stemming from the new concepts (Fig. 3).

2.3.1. Apple Dried Pomace

The fresh pomace, recovered immediately after pressing, underwent a 48-hour drying process at 35°C using two vertical dryers (Klarstein Jerky Steel). Subsequently, the dehydrated product was finely milled using a stone grain mill (Komo Fidibus XL), resulting in 12 kg of pomace flour from 80 kg of fresh pomace. The apple pomace was provided by Cascina Danesa was a blend of five organic varieties—Runzè, Magnana, Renetta Champagne, Jonagold, Stayman—resulting from the by-product of low-pressure apple pressing via a pneumatic press to extract juice.

2.3.2. Preliminary Edible Prototypes

At the end of this phase 5 new processed foods at TRL level 3 are obtained. The phase included 8 laboratory trials, testing 5 different dough formulations for each concept selected, incorporating varying percentages of apple dried pomace ranging from 5% to 30%. This step facilitated the exploration of

formal characteristics through experimentation with diverse shapes, sizes, textures, colours, and ingredient combinations.

The prototyping phase started at Panacea Social Farm's laboratory. Collaborating with bakers, 5 new concepts were chosen for exploration: gluten-free biscuits and savoury snacks, breadsticks, crackers, and muffins. The two working groups collaborated, sharing their respective skills and knowledge, to formulate the recipes and to create prototypes, adhering to the guidelines established during the concept generation phase.

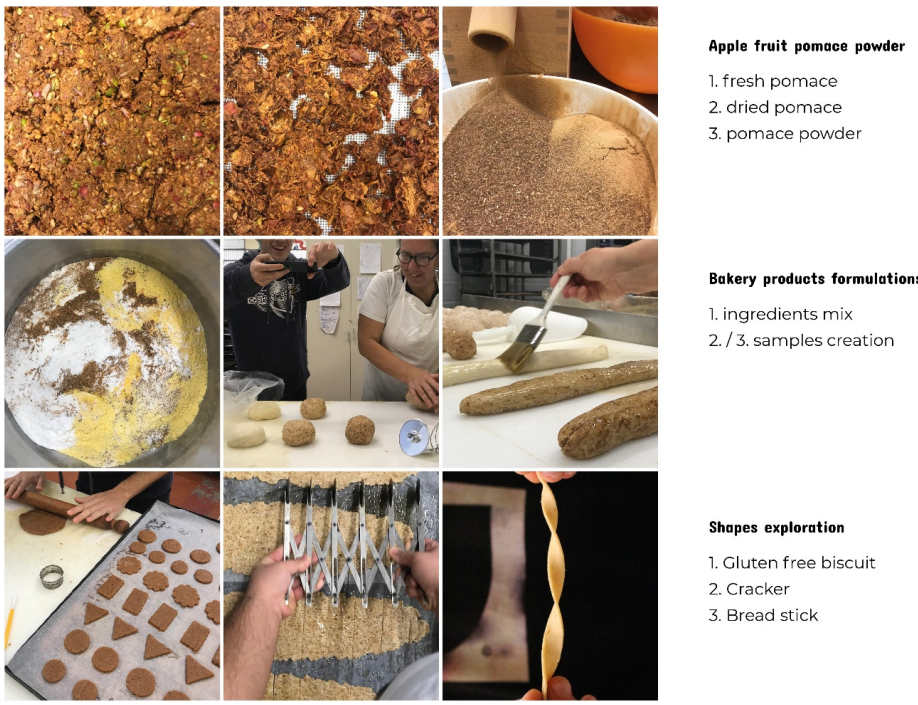

Fig. 3. Prototyping Phase. Some Shots of prototyping activities. **Source:** image by Authors.

2.4. Testing and Evaluation. Phase 4

The evaluation of the 5 prototypes—in terms of nutritional value, production costs, and consumer acceptance—is currently being outlined. Various activities are scheduled from February 2024, encompassing microbiological and nutritional assessments by a chemical laboratory, food cost evaluations by a consultant, and sensory evaluations conducted by a university research group with whom we collaborate.

The first gluten-free prototypes (biscuits and savoury snacks) were presented at two events on the circular economy in Turin (December 2023), where the participants - all experts in the field of circular economy - provided a generally positive assessment, encompassing both organoleptic and aesthetic dimensions of the products.

3. Preliminary Outcomes

The initial findings highlight the efficacy of a transdisciplinary approach, integrating both practical and theoretical knowledge, to elevate the value of by-products and explore novel applications in food production. This approach transforms food into a material for the design process (Lerma et al., 2012), engaging various stakeholders and fostering collective creativity (Sanders, 2001). By mediating different

knowledge throughout the different project phases (Celaschi, 2008), design researchers embraced the domain of Design With Food (Zampollo, 2016), facilitating the progression from scenario analysis to concept development and from initial low-fidelity experiments to the realisation of 5 preliminary edible prototypes.

In the "food product" dimension, the professional bakers participating in the experiment recognize the potential value of apple fruit pomace as a valuable ingredient, enhancing the diversity of their gastronomic offer (Fig. 4). Particularly remarkable is the formulation of new gluten-free foods, using rice flour, which enhances organoleptic and aesthetic characteristics compared to formulations without apple pomace. Organoleptically, the products maintain the primary aromas of the apple, resulting in a fruity flavour. Aesthetically, the incorporation of pomace flour imparts an "artisanal" appearance, similar to whole grain products.

From a systemic perspective, fruit producers engaged in the project envision the recovery of apple pomace as a viable profit strategy that can be integrated into the commercial activities of selling apples and their derived products. The relatively low complexity of pomace recovery in terms of time, equipment, and activity suggests the potential for further experimentation, aiming to valorise this by-product by developing a new and edible semi-finished product.

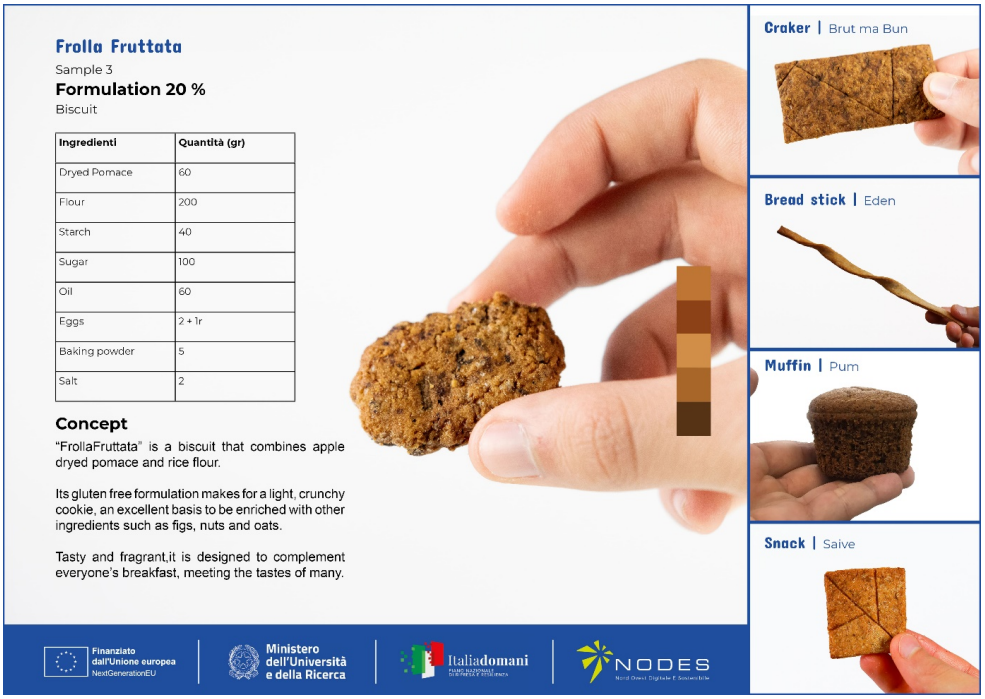

Fig. 4. New Prototypes. The 5 preliminary new products from apple fruit dried pomace. **Source:** image by Authors.

4. Conclusions and Future Developments

Preliminary findings indicate that exploring alternatives for reuse apple pomace in the formulation of new processed foods is a promising strategy for further investigation. This suggests the potential to transform a food waste into a valuable new resource for both producers and bakers.

While existing research underscores that apple pomace *"can be considered a safe product that can be successfully used in the food chain as part of the circular economy framework"* (Sionek, 2022), and highlights its role as a reliable and low-cost source of dietary fibre, antioxidants, and other nutrients (Carunchia, 2015), the experimentation conducted by the Polito Food Design Lab examine into the practical aspects of creating new food products. This work encompasses formulation, aesthetic considerations, and organoleptic dimensions. The new products demonstrate the feasibility of developing recipes that satisfy both the taste and the artisanal characteristics inherent in bakery products.

In light of these initial insights, future developments are required to address different aspects. This includes the nutritional assessments, the cost of production, the sensory evaluation, the consumer needs and possible customer targets. Furthermore, a crucial area of research concerns the legislations governing the (re)use of fruit by-products in the food industry, which requires in-depth investigations to

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