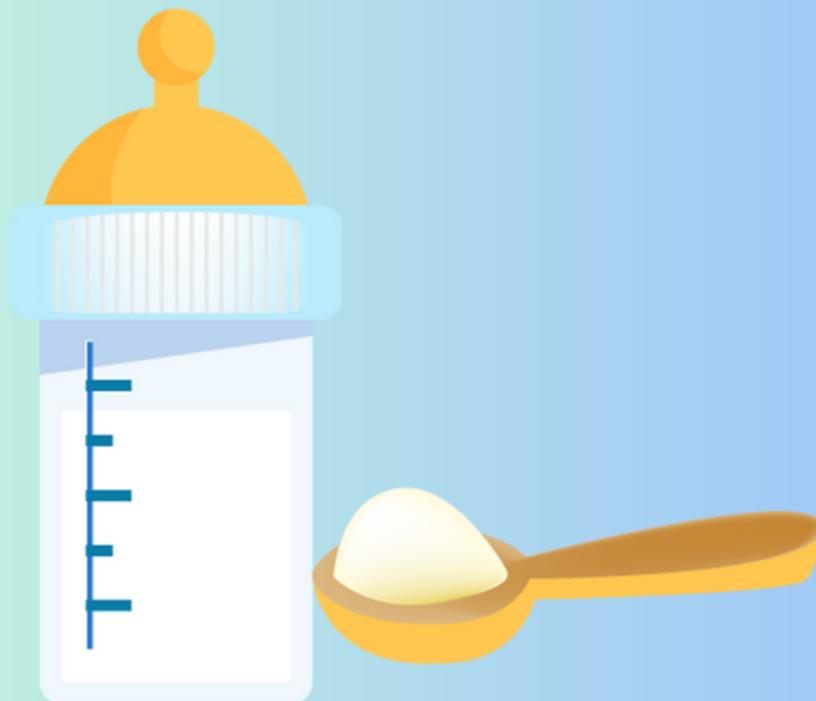


The Italian Market of Plant-based Infant Formula

Exploring Italian Parents' and Caregivers' Perspectives and Preferences regarding Infant Nutrition Products



Graduation Research Project

Sofia Miller - 3028704 - International Food Business

This report is written by a student of Aeres University of Applied Sciences (Aeres UAS). This is not an official publication of Aeres UAS. The views and opinions expressed in this report are those of the author and do not necessarily reflect the official policy or position of Aeres UAS, as they are based only on very limited and dated open source information. Assumptions made within the analysis are not reflective of the position of Aeres UAS. And will therefore assume no responsibility for any errors or omissions in the content of this report. In no event shall Aeres UAS be liable for any special, direct, indirect, consequential, or incidental damages or any damages whatsoever, whether in an action of contract, negligence or other tort, arising out of or in connection with this report.

Title:

The Italian Market of Plant-Based Infant Formula

Author:

Sofia Miller
3028704@aeres.nl

Date:

August 13th, 2023

Graduation Coach:

Cynthia Akkermans
c.akkermans@aeres.nl

Location:

Como, Italy



Preface

This thesis research focuses on an important topic in the world of infant nutrition: the market for plant-based infant formula. Driven by my personal interests and curiosities, I, Sofia Miller, have chosen to delve into this topic to explore the inclinations of Italian parents towards opting for plant-based infant formula. This report focuses on exploring the intersection of food, health, innovation, and sustainability in infant nutrition. Through this research, I wish to provide valuable insights into the attitudes and behaviours of Italian parents towards plant-based child nutrition, and to identify the factors that influence their opinions and decision-making processes.

This report will be of great interest to actors and stakeholders working in the infant formula industry, as well as parents who are looking for information on plant-based alternatives for their children.

I would like to express my sincere gratitude to my mentor and academic guide, Professor Cynthia Akkermans, for her unwavering support, expert guidance, constructive feedback, and valuable insights throughout the journey of writing this thesis. Her professionalism and high standards have enabled me to push myself to the extra mile, refining my work and elevating it to a level I am proud of.

I extend my appreciation to Marc Boxen, my second assessor, for his valuable feedback and pertinent suggestions that have contributed to the improvement of this research.

This thesis serves as a testament to the knowledge and skills I have developed during my three years at AERES University of Applied Sciences (Netherlands) and one year at Dalhousie University (Canada), which I will treasure as an investment for my future endeavours in the food industry.

I would also like to express my sincere gratitude to my exceptional colleagues and peers at Planted Italy, a ground-breaking company leading the way in the plant-based sector. Their support during my internship has enabled me to truly delve into my passion and expand my academic expertise within the professional domain.

Finally, I would like to extend heartfelt thanks to my fellow classmates and university peers, whose unwavering support has been a constant source of inspiration, propelling me forward throughout my bachelor's journey.

Table of Contents

SUMMARY	4
1. INTRODUCTION	5
1.1 THE ROLE OF INFANT FORMULA.....	5
1.2 THE SOCIAL IMPACT OF INFANT FORMULA	6
1.3 THE ENVIRONMENTAL IMPACT OF INFANT FORMULA.....	7
1.4 THE COMPOSITION OF BREASTMILK AND INFANT FORMULA	9
1.4.1 <i>The Composition of Breastmilk</i>	9
1.4.2 <i>Composition of Cows' Milk Infant Formula</i>	10
1.4.3 <i>Composition of Soy-based infant formula</i>	10
1.5 THE BENEFITS AND DRAWBACKS OF PLANT-BASED INFANT FORMULA	11
1.5.1 <i>Food Allergies</i>	11
1.5.2 <i>Health Benefits and Drawbacks of Soy-based Formula</i>	11
1.6 THE MARKET OF SOY-BASED INFANT FORMULA	12
1.7 FACTORS THAT INFLUENCE CONSUMER'S DIETARY CHOICES	13
1.8 KNOWLEDGE GAP AND RESEARCH TARGET	14
2. RESEARCH PROPOSAL	16
2.1 RESEARCH METHOD	16
2.2 RESEARCH PLAN	16
2.3 RESEARCH VARIABLES	17
2.4 DATA TESTING.....	19
3. RESULTS	21
3.1 SUB-QUESTION 1: IMPACT OF DEMOGRAPHIC FACTORS	21
3.2 SUB-QUESTION 2: PREFERRED PLANT-BASED INGREDIENT FOR BMS	26
3.3 SUB-QUESTION 3: THE IMPORTANCE OF PRODUCT ATTRIBUTES AND QUALITY MARKS.....	28
3.4 SUB-QUESTION 4: MISCONCEPTIONS AND DRAWBACKS RELATED TO PLANT-BASED BMS.....	30
4. DISCUSSION OF RESULTS	32
4.1 REFLECTION ON METHODOLOGY	32
4.2 LIKELIHOOD OF ITALIAN PARENTS OF CHOOSING PLANT-BASED INFANT FORMULA	33
4.3 IMPACT OF DEMOGRAPHIC FACTORS	33
4.4 PREFERRED PLANT-BASED INGREDIENT FOR BMS	36
4.5 THE IMPORTANCE OF PRODUCT ATTRIBUTES AND QUALITY MARKS.....	37
4.6 MISCONCEPTIONS AND DRAWBACKS RELATED TO PLANT-BASED BMS.....	39
5. CONCLUSIONS AND RECOMMENDATIONS	40
5.1 CONCLUSIONS	40
5.2 RECOMMENDATIONS	41
REFERENCE LIST	43
APPENDIX 1: CONSUMER SURVEY (ENGLISH)	48
APPENDIX 2: CONSUMER SURVEY (ITALIAN - ORIGINAL)	51

Summary

This study examines the landscape of infant nutrition in Italy, specifically focusing on plant-based infant formula - also referred as breastmilk substitutes (BMS) - as an alternative to traditional dairy-based products. As concerns about dairy allergies and the environmental impact of milk production grow, parents seek plant-based alternatives for their children, leading to increased demand in this niche market. However, scepticism among Italian parents about plant-based diets persists. The research aims to uncover Italian parents' attitudes towards plant-based infant formula and the factors influencing their choices. The main research question reads: *"To which degree would Italian parents and caregivers consider utilising plant-based breastmilk substitutes for their children?"*.

To support the main question, four sub-questions have been formulated, investigating the demographic factors of influence, the most favoured plant-based ingredients in infant formula, the importance of product attributes and quality marks, and the misconceptions and drawbacks concerning plant-based nutrition in infants.

To gather the necessary data to answer the research questions, a consumer survey was distributed among Italian parents and caregivers, reaching a total of 60 responses belonging to this target group.

The results of the survey revealed a cautious stance among Italian parents, with a mean willingness to adopt plant-based infant formula of 2.68 out of 5.

Expectant parents display greater openness, indicating a positive intention among those yet to assess the practical needs of childcare. Additionally, vegan parents show a stronger preference for plant-based formula, suggesting potential growth as plant-based diets become more popular in Italian households.

Parents' previous experience with infant formula also plays a significant role, as those without prior experience tend to lean towards plant-based options. Among formula-experienced parents, cow's milk remains the preferred base ingredient. In this study, Hydrolysed Vegetable Proteins emerge as the most popular plant-based ingredient for infant formula, yet being chosen by only 7 percent of survey respondents.

Nutritional claims on product packaging, supported by medical advice, product availability in commercial stores, and specific quality marks like "Dairy Free", "Organic", and "Fortified with Nutrients" significantly influence parents' inclination towards plant-based formula. However, concerns among less enthusiastic groups of consumers revolve around the discouraging recommendations of doctors regarding the safety of plant-based diets in child development.

Collaboration with healthcare institutions and manufacturers can prove plant-based formula as a safe alternative. Moreover, improving the accessibility and affordability of these products is essential to enhance competitiveness in the market, while partnering with retailers can boost visibility. Lastly, targeted educational campaigns can dispel misconceptions, fostering greater parental confidence in plant-based options.

1. Introduction

1.1 The Role of Infant Formula

The study of dietary patterns in the early stages of human life is a relevant research topic for a comprehensive understanding of the relationship between nutrition and child development. The objective of early dietary patterns studies is to build scientific and evidence-based knowledge to provide advice and guidelines to the population on how to support children's physical, mental, and social well-being through nutrition (Martín-Rodríguez et al., 2022).

In 2015, the Academy of Nutrition and Dietetics made a definitive conclusion about the vital role of **breastfeeding** in infants' development, immunological health, and early survival (Victora et al., 2016). This is particularly significant in situations where newborns and infants face elevated risks of mortality due to premature birth or conditions like gastroenteritis, pneumonia, and undernourishment (Victora et al., 2016). The overall duration of the breastfeeding phase has been linked to the degree of risk of developing childhood infections, mental health issues or disorders, and non-transmittable diseases, such as obesity and diabetes (Victora et al., 2016).

Therefore, the World Health Organization (WHO) strongly recommends exclusive breastfeeding throughout at least the first six months of a newborn's life (WHO, 2021). After six months, breastfeeding can be followed or supplemented with complementary foods, such as infant formula, up to and beyond two years of age (WHO, 2021).

Even though most mothers are physically able to breastfeed, several health, cultural, historical, and socio-economic factors may influence women's choice to initiate and/or carry out breastfeeding throughout the first year of life of their newborn (WHO, 2021). In fact, according to a fact sheet published by the World Health Organisation in 2021, only 44 percent of infants worldwide aged 0–6 months are exclusively breastfed (WHO, 2021). In low- and middle-income countries, only 37 percent of children under 6 months are exclusively breastfed (Victora et al., 2016).

To support the large number of mothers worldwide who are unable or choose not to exclusively breastfeed their children, the World Health Organisation (WHO) highlights the importance of **breastmilk substitutes (BMS)** as a safe, nutritious, accessible, and affordable alternative for those infants and mothers that cannot benefit of sufficient access to breastmilk (WHO, 2021).

1.2 The Social Impact of Infant Formula

To protect and promote the practice of breastfeeding among mothers and caregivers, the World Health Assembly adopted *'The International Code of Marketing of Breastmilk Substitutes'*, which provides regulations for the appropriate marketing and distribution of breastmilk substitutes (BMS) to the population (WHO, 2021). This highlights the great social impact that the advertising of infant nutrition products has on parents and children worldwide.

Despite the active encouragement and promotion of breastfeeding, **breastmilk substitutes** are still the main (or only) source of nutrition for many infants worldwide (Barenes et al., 2012). This implies that access to safe, affordable, and high-quality BMS is a matter of survival for many newborns, especially in cases of premature births, undernourishment, food allergies, or immune system deficiencies (Barenes et al., 2012). Hence, all commercially available breastmilk substitutes sold in Europe must be developed and produced by specialised, licenced organisations in the food manufacturing and pharmaceutical industry (European Parliament and Council, 2013). These organisations are endowed with R&D departments of high expertise to guarantee the safety, adequacy, and nutritional sufficiency of BMS and their compliance with national and international standards (European Parliament and Council, 2013).

Moreover, researching and understanding the market of breastmilk substitutes helps to better visualise and design solutions for the pursuit of the United Nations' 17 **Sustainable Development Goals** (SDG), a display of social and environmental goals that nations are bound to be pursued collectively.

Breastmilk substitutes are a relevant product for the 2nd SDG *"Zero Hunger"*, as they represent a systematic source of nutrition for many infants across the world (WHO, 2021). Therefore, BMS are considered to be a first-need product for the correct and complete nourishment of newborns (WHO, 2021).

The impact of breastmilk substitutes is also linked to the 3rd SDG, *"Good Health and Well-Being"*, as these are proven to be necessary for the adequate development, immunological health, and early survival of non-breastfeeding children, while being a contributing factor in the reduction of mortality rates in new-borns and infants (Victora et al., 2016).

Furthermore, breastmilk substitutes are also a driver of influence for the 5th and 10th SDGs, *"Gender Equality"* and *"Reduced Inequalities"*, as BMS represent an efficient feeding alternative for many working mothers that are unable to nourish their children exclusively through breastfeeding (Brown et al., 2011). Therefore, providing access to safe and affordable BMS may enable parents and caregivers to better share the responsibility of feeding and nourishing their children more equally.

1.3 The Environmental Impact of Infant Formula

According to a publication by Altmann & Hill (2019), formula-fed infants should consume about 75 ml of infant formula per pound (453 g) of their body weight, with an average total of 960 ml a day (Altmann & Hill, 2019). Applying this data to a 6-month time span – when babies must be exclusively fed breastmilk or infant formula – it is deducted that an average newborn consumes 175 litres of infant formula in the first 6 months of life on average (Altmann & Hill, 2019). This data logically suggests that the industrial production and widespread consumption of BMS may entail a relevant environmental impact when analysing the bigger picture from a global perspective.

First-food systems are increasingly being researched as they are partly drivers of various health and ecological crises (Pope et al., 2021). Their innovation and sustainable development are recognised as key opportunities for planetary health (Pope et al., 2021). Even though breastfeeding represents the most optimal source of nutrition for infants, the use of breastmilk substitutes is highly popular and growing rapidly (Pope et al., 2021). Cows' milk is the main ingredient in breastmilk substitute products, making the role of the dairy industry a key topic of environmental analysis (Andresen et al., 2022).

The publication by Andresen et al. (2022) finds that BMS made with cows' milk produces double the amount of carbon emissions compared to breastfeeding, while one kilogram of BMS has a blue water footprint of almost 700 litres (Andresen et al., 2022). Thus, BMS have a relevant environmental impact (Andresen et al., 2022).

The measurement and analysis of the environmental impact of the production and consumption of milk enables to collect the necessary data for the improvement of the agricultural production and consumption processes involved (Poore & Nemecek, 2018).

Bovine milk, the main ingredient used in BMS, must be further processed to resemble human milk in its nutritional value, functionality, and palatability, and become suitable as a main source of nutrition for infants (Martin et al., 2016). Even though bovine milk is the most common base ingredient contained in commercial BMS, it is not implied that it is the most environmentally-friendly source of nutrients for the artificial replacement of human breastmilk (Poore & Nemecek, 2018).

In fact, despite the remarkable nutritional quality of bovine milk, the global production and maintenance of dairy livestock are estimated to contribute to more than 4 percent of the total greenhouse gas (GHG) anthropogenic emissions produced globally (FAO, 2019). In addition, the systematic production of dairy milk is associated with the competition for agricultural resources, the depletion of arable land, freshwater and soil pollution, and with the significant loss of biodiversity worldwide (FAO, 2019).

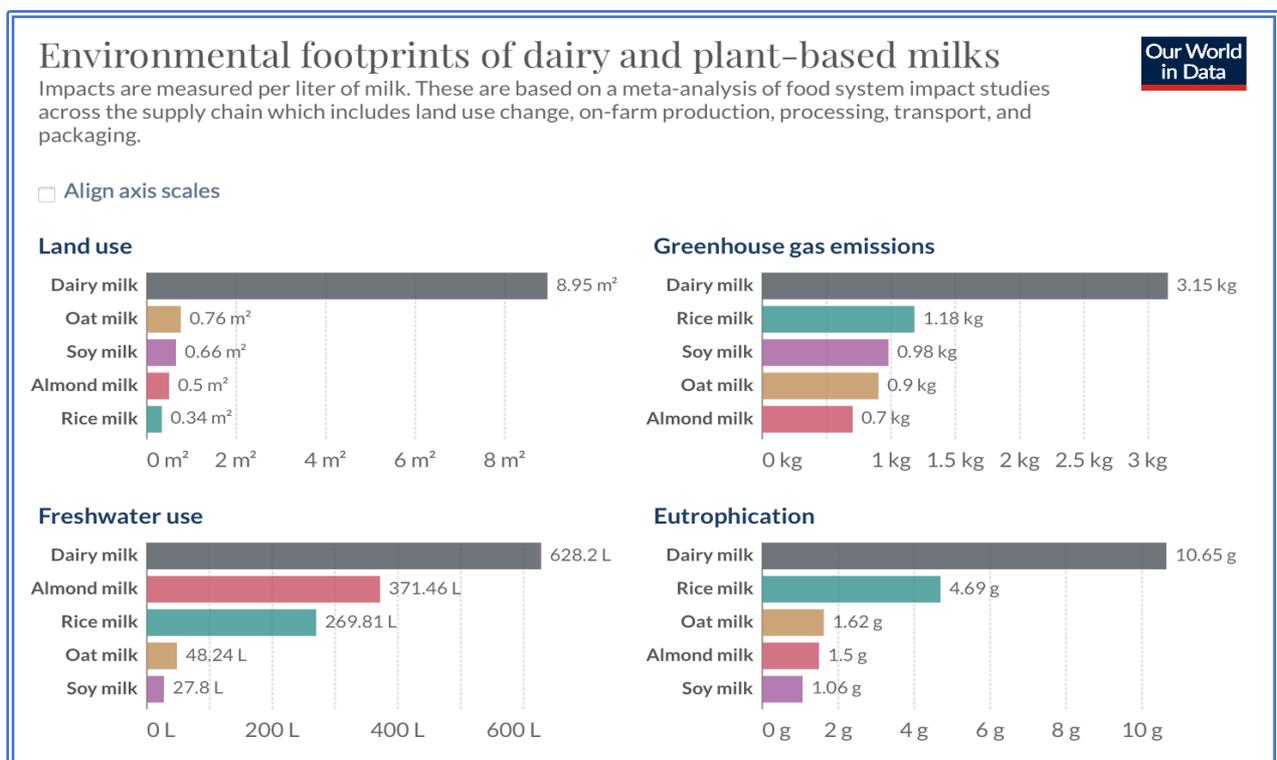
According to research conducted by Poore and Nemecek (2018), animal-based food products have a higher ecological footprint compared to plant-based foods, due to the GHG emissions produced by the enteric fermentation of ruminant animals, and the

processes of feed production and manure management. Figure 1 displays a comparison of the environmental impact (land use, greenhouse gas emissions, freshwater use and eutrophication) of dairy milk versus plant-based milk (soy milk, rice milk, oat milk and almond milk) (Poore & Nemecek, 2018).

This data also highlights the connection between the infant nutrition industry with Sustainable Development Goals number 12 *“Responsible Consumption and Production”*, number 13 *“Climate Action”*, and number 15 *“Life on Land”*. The data foreshows approachable challenges for the sustainable development of the infant formula industry, which can be strategically approached by designing new sourcing practices that are less damaging to the environment (Poore & Nemecek, 2018). The use of plant-based ingredients for the production of commercial infant formula could represent a possible solution for the sustainable transition of the child nutrition industry.

In conclusion, investing, developing, and putting effort into improving plant-based breastmilk substitutes could inspire solutions for the diversification of production and supply of ingredients, to transition towards a more sustainable food system (Poore & Nemecek, 2018).

Figure 1:
Environmental impact of dairy and plant-based milk (Poore & Nemecek, 2018).



1.4 The Composition of Breastmilk and Infant Formula

Based on the study conducted by Andreas et al. (2015), human breast milk undergoes compositional changes in response to various factors, ensuring it meets the evolving nutritional needs of infants as they grow (Andreas et al., 2015). As a highly intricate and variable biofluid, breast milk has evolved over time to provide infants with essential nourishment and protection against diseases while their immune system develops (Andreas et al., 2015). The unique composition of breast milk is widely recognized as biologically tailored to meet the precise nutritional requirements of each individual infant, making it challenging to replicate in a universal form (Andreas et al., 2015). Thus, the study and biochemical analysis of breastmilk composition is an essential source of data for the R&D and product development stages of commercial BMS (Martin et al., 2016). The main function of commercial breastmilk substitutes is to resemble the nutritional composition of human breastmilk by combining different ingredients and nutrient sources (Martin et al., 2016). This implies that all base ingredients used in commercial BMS must be further processed and fortified with nutrients to reflect the nutritional requirements of newborns and infants (Martin et al., 2016).

1.4.1 The Composition of Breastmilk

According to the study conducted by Andreas et al. (2015), human breast milk contains several crucial biochemical components. Lipids, comprising over 200 fatty acids, are the primary source of energy, contributing to 40-55 percent of breast milk's total energy content (Andreas et al., 2015). Triacylglycerides make up 98 percent of the lipid fraction (Andreas et al., 2015). Additionally, breast milk contains over 400 proteins that provide cell-building nutrition, aid nutrient absorption, and stimulate antimicrobial and immunomodulatory activities (Andreas et al., 2015). These proteins can be classified, based on solubility, into caseins, whey, and mucin proteins (Andreas et al., 2015). Non-protein nitrogen, including free amino acids, urea, creatinine, nucleotides, and peptides, plays a role in metabolic and enzymatic activities (Andreas et al., 2015).

Moreover, immunoglobulins, crucial for immunological development, are found in high concentrations in colostrum, providing protection to the infant's immature immune system (Andreas et al., 2015). Over time, the immunoglobulin content decreases as the infant's immune system matures (Andreas et al., 2015). Human breast milk also contains a variety of complex carbohydrates, with lactose being the most abundant due to the high energy demands of the human brain (Andreas et al., 2015). Human milk oligosaccharides (HMO), a significant fraction of breast milk, act as prebiotics, nourishing beneficial bacteria in the infant's gastrointestinal tract, such as *Bifidobacterium Infantis* (Andreas et al., 2015).

1.4.2 Composition of Cows' Milk Infant Formula

According to the research by Martin et al. (2016), bovine milk, the primary base-ingredient in breastmilk substitutes, differs in its composition from human breast milk, as bovine milk contains higher levels of fat, minerals, and casein (Martin et al., 2016). Therefore, to resemble the composition of human breast milk, bovine milk used in BMS needs to be diluted (Martin et al., 2016). The process involves skimming the milk to reduce fat content and adding additional whey proteins to achieve a protein composition similar to human milk, which has a higher proportion of whey proteins (Martin et al., 2016). To increase the carbohydrate content, lactose or glucose syrup is added to the bovine milk used in BMS (Martin et al., 2016). Additionally, a combination of vegetable oils is utilized to supplement unsaturated fatty acids, and a mixture of vitamins and minerals is added to meet the nutritional needs of newborns (Martin et al., 2016).

Furthermore, the supplementation of probiotics and prebiotics in cow's milk BMS, including human milk oligosaccharides, plays a vital role in the development of the gut microbiota and immune system in newborns (Martin et al., 2016). The inclusion of prebiotics in infant formula is considered an important strategy to reduce the frequency and severity of diarrhoea and infections in infants (Martin et al., 2016).

1.4.3 Composition of Soy-based infant formula

Soy infant formula is made from soybean protein and comes in both powder and liquid form (Vennemann et al., 2009). Soy-based formulas are naturally lactose-free and contain a different type of sugar compared to dairy milk (Vennemann et al., 2009). Soy infant formulas are usually fortified with iron to compensate for the inhibitory effect soy protein has on iron absorption (Vennemann et al., 2009).

One of the main misconceptions about soy-based infant formula that was popular among parents in the past is the potential health risk once associated with high levels of isoflavones contained in soy (Vennemann et al., 2009). Isoflavones are a type of phytoestrogen contained in soybeans that may have effects on infants that are still being researched (Vennemann et al., 2009). Soy-based BMS contain 32-47 mg per litre of total isoflavones (Vennemann et al., 2009). In contrast, human milk has negligible levels of isoflavones. Infants fed soy-based formula consume about 22-45 mg of isoflavones per day, which, since conducting recent research on the topic, are believed to translate into long-term health benefits, such as the reduced risk of hormone-dependent diseases (Vennemann et al., 2009).

1.5 The Benefits and Drawbacks of Plant-based Infant Formula

1.5.1 Food Allergies

Cow's milk, being a common base ingredient in breastmilk substitutes (BMS), is often introduced early in an infant's diet and can lead to milk allergy, affecting 2-5 percent of babies and young children worldwide (Martin et al., 2016; Fiocchi et al., 2010). Symptoms typically emerge after breastfeeding cessation and cow's milk introduction, while breastfed infants rarely experience symptoms (Martin et al., 2016). Eliminating cow's milk poses nutritional risks as it serves as a primary source of protein, fat, calcium, phosphorus, and vitamin B12 for infants (Verduci et al., 2019).

Specialty infant formulas, designed for specific nutritional needs or allergies, incorporate alternative sources (Verduci et al., 2019). Soy-based formulas, well-tolerated by infants with cow's milk allergy, are supplemented with essential amino acids, zinc, calcium, iron, and phosphorus (Verduci et al., 2019). Soy formulas are not recommended for allergy-prone infants due to soy's allergenic nature (Verduci et al., 2019).

Rice, a hypo-allergenic food, is another base ingredient used in specialty formulas (Verduci et al., 2019). Rice-based formulas, including hydrolysed rice proteins, have been developed as alternatives (Verduci et al., 2019). To ensure nutritional adequacy, lysine, threonine, tryptophan, carnitine, taurine, iron, and zinc are added to partially hydrolysed rice protein formulas (Verduci et al., 2019). However, rice proteins lack sufficient essential amino acid content, necessitating supplementation (Verduci et al., 2019). These specialized formulas provide a complete nutritional profile for infants allergic to cow's milk or soy (Verduci et al., 2019).

1.5.2 Health Benefits and Drawbacks of Soy-based Formula

Soy-based infant formulas have a long history of safe use and few reported negative health effects (Westmark, 2017). Consumption of soy protein in adulthood is associated with various health benefits and provides an economical approach to delivering essential nutrients to infants (Westmark, 2017). The United States Food and Drug Administration (FDA) supports soy health claims, allowing products with at least 6.25 grams of soy protein to carry the claim of potentially reducing the risk of cardiovascular disease (Westmark, 2017).

However, the safety of soy-based infant formulas requires further rigorous examination, particularly regarding potential health effects related to phytoestrogens, agrochemicals, and genetically-modified soy components (Westmark, 2017). Additionally, there is a lack of systematic reviews examining infant growth metrics in relation to the use of soy-based formulas (Westmark, 2017). Although current evidence does not indicate significant differences in growth between infants fed cow's milk formula and those fed soy-based formula, further comprehensive research is needed to substantiate this claim (Westmark, 2017).

Moreover, advancements in technology have improved the overall quality of soy infant formula, enhancing its digestibility and nutritional suitability for the target population (Vandenplas et al., 2021). Careful development of the nutrient formulation in soy-based breastmilk substitutes (BMS) is crucial to meet the specific nutrient requirements of infants and address potential deficiencies, such as iron deficiency or inadequate fiber levels, in the target population (Vandenplas et al., 2021).

1.6 The Market of Soy-Based Infant Formula

A recent analysis by Data Bridge Market Research (2022) indicates that the global market for soy-based infant formula reached a value of USD 241.11 million in 2021 and is projected to reach USD 399.04 million by 2029 (Data Bridge, 2022). The market is expected to grow at a compound annual growth rate of 3.5 percent between 2022 and 2027 (Expert Market Research, 2021).

However, it is important to note that the plant-based infant formula market represents a niche segment within the overall infant formula market (Fortune Business Insights, 2020). Fortune Business Insights estimated the global infant formula market (including all types) to be valued at USD 50.46 billion in 2019, with a projected value of USD 109.10 billion by 2027 (Fortune Business Insights, 2020). This suggests that plant-based formulas account for a small portion (approximately 0.4 percent) of the total market (Fortune Business Insights, 2020).

The growth of the soy-based infant formula industry is fueled by various factors, as highlighted in the report by Expert Market Research. These factors include the increasing number of working women, the rise of vegetarian and vegan families, consumer trust in infant nutrition brands, growing concerns for safety and nutrition, rising disposable income, and demand from emerging economies (Expert Market Research, 2021). Parental concerns about chemical additives in traditional cow's milk formulas and the demand for organic breastmilk substitutes are also contributing to market expansion (Expert Market Research, 2021).

The soy-based infant formula market is experiencing growth across regions such as North America, Latin America, Europe, the Middle East and Africa, and the Asia Pacific (Expert Market Research, 2021). However, the distribution of market share between plant-based and dairy-based products in the future remains uncertain (Expert Market Research, 2021). Consumer perception, acceptance of plant-based alternatives, and the willingness of parents and caregivers to incorporate such products into their children's diets may play a significant role (Expert Market Research, 2021). Additionally, factors such as price, accessibility, and availability of plant-based formulas in different regions can influence consumer preferences and purchasing decisions (Expert Market Research, 2021).

1.7 Factors that Influence Consumer's Dietary Choices

The decision to adopt a plant-based diet can be influenced by various demographic factors (Fehér et al., 2020). Research conducted by Modlinska et al. (2020) has demonstrated that the perception of meat consumption as a masculine trait is associated with lower adoption of plant-based diets among men (Modlinska et al., 2020). Conversely, women are more likely to have positive perceptions of plant-based diets and adopt them in adulthood (Modlinska et al., 2020), indicating that gender plays a significant role in the propensity to shift towards a vegan diet.

Moreover, younger consumers tend to prioritize environmental sustainability and animal welfare, which are key drivers for the adoption of plant-based diets (Fehér et al., 2020). Additionally, individuals living in urban areas may have greater access to plant-based options due to the prevalence of health food stores and vegan restaurants (Fehér et al., 2020). Income level can also play a role, as higher-income individuals often choose plant-based diets due to the perception of them being healthier and more upscale (Fehér et al., 2020). Cultural and religious factors can also impact dietary choices, with some religions promoting vegetarianism or veganism as part of their beliefs (Fehér et al., 2020).

When selecting infant formula, parents prioritize certain attributes to ensure their baby receives optimal nutrition (Altmann & Hill, 2021). In addition to the primary ingredient listed, consumers often prefer formulas that contain Docosahexaenoic acid (DHA), an Omega-3 fatty acid important for brain and eye development (Altmann & Hill, 2021). Organic formulas and those regulated by government policy may also be sought after by parents (Altmann & Hill, 2021). Other important attributes include the protein source, whether the formula is designed for specific medical conditions, and its digestibility (Altmann & Hill, 2021). Some parents may also look for formulas fortified with or free from certain ingredients, such as heavy metals or corn syrup (Altmann & Hill, 2021).

Moreover, the factors contributing to parents' hesitation in embracing a vegan diet for their families are also a pertinent area of research. Concerns about nutrient deficiencies, limited food choices, social stigma, and perceived difficulties in meeting the dietary needs of growing children all contribute to their reluctance to adopt a plant-based lifestyle (Bivi et al., 2021). A study by Bivi et al. (2021) emphasizes that effective communication barriers with primary care paediatricians are a source of apprehension for many vegan parents (Bivi et al., 2021). The study also reveals that more than 70 percent of primary care paediatricians were perceived as sceptical or against a vegan diet for children, often due to popular misconceptions or outdated scientific research (Bivi et al., 2021). Vegan diets are often mistakenly viewed as calorie- or nutrient-restricted, despite the fact that they can include a wide variety of nutrient-dense foods, such as vegetables, fruit, legumes, whole grains, pseudo cereals, soy derivatives, nuts, seeds, plant oils, herbs and spices (Bivi et al., 2021).

Although well-balanced plant-based diets offer several nutritional benefits, the misconceptions surrounding their adequacy for children can deter parents and caregivers from adopting such diets (Bivi et al., 2021). Micronutrient deficiencies and protein deficiencies are among the most widely spread misconceptions about vegan diets within the medical and scientific community (Bivi et al., 2021). However, whole plants contain all nine essential amino acids necessary for survival, and a properly planned diet can provide adequate protein intake (Bivi et al., 2021). Combining different plant-based protein sources is a safe and effective way to ensure a complete amino acid profile (Bivi et al., 2021).

1.8 Knowledge Gap and Research Target

The literature review on parental and caregiver preferences regarding plant-based versus conventional cows' milk infant formula reveals a significant knowledge gap in three key areas. Firstly, it remains unclear which demographic factors primarily influence parents and caregivers when making purchasing decisions between the two options. Secondly, the preferred base ingredient for plant-based breastmilk substitutes has not been established, leaving room for consumer market exploration. Lastly, the specific product attributes and quality marks that could potentially incentivize consumers to choose plant-based infant formula over conventional cows' milk formula are yet to be determined.

In the context of Italian parents and caregivers, the extent to which they would consider utilizing plant-based breastmilk substitutes for their children remains largely unexplored. Addressing these gaps in knowledge is crucial for understanding the factors influencing consumer choices and can provide insights for healthcare professionals, policymakers, and manufacturers to better meet the needs and preferences of parents and caregivers in selecting infant formula options. Further research in this area will contribute to a more comprehensive understanding of parental decision-making regarding plant-based breastmilk substitutes in Italy.

The objective of this research is to find out whether there is a positive or negative attitude among Italian consumers towards plant-based infant formula for infants, and to find out what factors influence consumers' choices in regard to these products. The goal of collecting data and information on this topic is to empirically discuss whether the share of consumers choosing plant-based formula over cows' milk formula is expected to increase or decrease in the near future.

Moreover, the objective of this research is to collect information on how to sustainably transform the infant nutrition industry by reducing its reliance on animal agriculture. This information can be particularly relevant for businesses and stakeholders in the infant nutrition industry that wish to invest in the protein transition. For this reason, it is important to understand how consumers currently perceive plant-based milk as a source

of nutrition for children, and what factors are currently encouraging or inhibiting the transition towards plant-based alternatives for children.

To find out whether Italian parents and caregivers in the Italian market have a positive or negative attitude towards plant-based infant formula, the following main question was formulated as a lead for this research:

To which degree would Italian parents and caregivers consider utilising plant-based breastmilk substitutes for their children?

To support the main research question, four sub-questions have been formulated:

1. What are the main demographic factors that influence the choice of parents and caregivers when purchasing plant-based or conventional cow's milk infant formula?

This question aims to collect data on factors that may influence consumer's buying choices in relation to infant formula, such as gender, parental status, type of diet, and previous experience with breastmilk substitutes. This data will be compared to their likelihood of choosing plant-based formula over traditional cow's milk formula.

2. What is the most preferred base ingredient for plant-based breastmilk substitutes?

This question aims to point out which vegan base ingredient has the highest potential in the market according to parents with previous experience using breastmilk substitutes.

3. What product attributes and quality marks can be incentives for consumers to choose plant-based BMS over conventional cows' milk BMS?

This question compares the attributes and quality marks parents highly value in breastmilk substitutes to their likelihood of considering plant-based infant formula.

4. What factors prevent consumers from choosing plant-based BMS over conventional cows' milk BMS?

This question aims to explore the factors that might make parents hesitant about approaching a plant-based diet for their children. This will be done by exploring how widespread misconceptions about plant-based diets in children are in Italy.

2. Research Proposal

2.1 Research Method

To answer all four sub-questions, a consumer survey (provided in the Appendix) was distributed among parents and caregivers in Italy. The challenge was to find as many respondents as possible from the target group: parents of children under the age of 4.

As displayed in Table 3, sub-question 1 was answered by collecting data through Questions 1, 2, 3, 4, 5, and 11 in the consumer survey. These questions aimed to collect data on the consumer's demographics and likelihood of utilizing plant-based formula.

To answer sub-question 2, survey Questions 5 and 9 were used to collect targeted data. Question 6 collected information on whether the consumer had previous experience with plant-based BMS. Question 9 investigated the preferred base-ingredient for plant-based formula by parents with previous experience using BMS. Table 4 displayed in detail how the survey questions matched sub-question 2.

Moreover, Table 5 displayed how survey Questions 7 and 8 answered sub-question 3 by investigating what product attributes and quality marks parents and caregivers considered important when selecting the right BMS for their children.

Lastly, common drawbacks that consumers might have perceived in relation to plant-based diets in children were investigated through Question 10 and displayed in Table 6.

2.2 Research Plan

The consumer survey was conducted from June 20th to July 10th, with an expected response rate of 30-50 respondents belonging to the research target group (parents of children aged 4 or under in Italy). Finding optimal distribution platforms was a possible hindrance to the collection of pertinent responders. Only 33 percent of Italian households (\approx 8,48 million households) were composed of couples with children, while only 3,8 percent (\approx 2.29 million people) of the Italian population were represented by children under 4 (ISTAT, 2021). The survey was distributed to parents of young children through word-of-mouth, social media platforms (Facebook groups, online communities), and physical hand-outs at strategic locations.

Once the data was gathered, a thorough analysis of the results was performed with the use of Mann-Whitney, Kruskal-Wallis, and Friedman statistical tests. This involved looking for trends, patterns, and correlations in the data, as well as examining the responses in detail. The information was used to develop insights into the target group's behavior and preferences.

2.3 Research Variables

The consumer survey that was conducted on parents and caregivers in Italy was based on quantitative research. The scope was to collect numerical data on the level of experience and acceptance of Italian parents and caregivers in relation to plant-based breastmilk substitutes.

A statistical analysis was conducted on the data collected through the consumer survey to be able to inferentially predict trends or relationships between variables. A general overview of the research variables is provided in Table 1 and Table 2 below.

Table 1:
Research Variables – Demographic Information on Consumer.

Demographic Information on Consumer			
1	Gender	Nominal Categorical	Male Female Non-binary
2	Parental Status	Nominal Categorical	No children Expecting Children age or under 4 Children over 4
3	Number of Family Incomes	Nominal Categorical	Single Income Two Incomes Others that apply
4	Type of Diet	Nominal Categorical	Omnivore Flexitarian Vegetarian Vegan Religious diet (Kosher, Halal...)
5	Experience using BMS	Nominal Categorical	Yes, in combination with breastfeeding Yes, exclusively No
6	Experience using plant-based BMS	Nominal Categorical	Yes – Exclusive use of plant-based formula Yes – In combination with traditional formula or breastfeeding No experience

Table 2:
Research Variables – Consumer Behaviour Survey.

Consumer Behaviour Survey			
7	Importance of attributes <ul style="list-style-type: none"> • Low Price • Product Format/Convenience • Doctor’s recommendations • Availability in commercial stores/supermarkets/pharmacies • Previous experience with product • Special nutritional claims 	Ordinal	1 (not important) 2 3 4 5 (very important)
8	Importance of quality marks <ul style="list-style-type: none"> • Organic • Dairy Free • Fortified with • Vegan 	Ordinal	1 (not important) 2 3 4 5 (very important)
9	Preferred BMS base-ingredient	Nominal Categorical	Cow Goat Soy Almond Rice Hydrolyzed plant protein Other
10	Misconceptions and drawbacks of plant-based BMS <ul style="list-style-type: none"> • Not nutritionally complete and adequate • Not safe for children during development • Hard to find vegan substitutes • Bad taste and be rejected by infants • Not recommended by medical community 	Nominal Categorical	True False I don’t know
11	Likelihood of choosing plant-based BMS	Ordinal	1 (extremely unlikely) 2 3 4 5 (very likely)

2.4 Data Testing

To answer the main question and the four sub-questions, the following statistical tests were applied in the data analysis process.

The following tables summarised what type of variables were implied in the research, while anticipating which statistical test or method of analysis was applied.

SUB-QUESTION 1: What are the main demographic factors that influence the choice of parents and caregivers when choosing between plant-based or conventional cows' milk infant formula?

Table 3:
Research Variables and Statistical Test for sub-question 1.

INDEPENDENT VARIABLE	DEPENDENT VARIABLE	Statistical Test
Q1 (gender)	Q11 (likelihood of purchasing plant-based infant formula)	Mann-Whitney
Q2 (parental status) Target group for data analysis: Consumers with children aged 4 or under	Q11 (likelihood of purchasing plant-based infant formula)	No statistical test, select the target group and analyse the general likelihood (Q10)
Q3 (number of incomes)	Q11 (likelihood of purchasing plant-based infant formula)	Kruskal Wallis
Q3 (type of diet)	Q11 (likelihood of purchasing plant-based infant formula)	Kruskal Wallis
Q4 (experience using BMS)	Q11 (likelihood of purchasing plant-based infant formula)	Kruskal Wallis
Q5 (experience using plant-based BMS)	Q11 (likelihood of purchasing plant-based infant formula)	Kruskal Wallis

SUB-QUESTION 2: What is the most preferred base-ingredient for plant-based breastmilk substitutes?

Table 4:
Research Variables and Statistical Test for sub-question 2.

INDEPENDENT VARIABLE	DEPENDENT VARIABLE	DATA ANALYSIS
Q5 (experience using BMS) Target group for data analysis: Consumers with previous experience using BMS	Q9 (Preferred BMS base-ingredient)	Find out which base-ingredient is the most popular within the <u>target group</u> (Consumers with previous experience using BMS)

SUB-QUESTION 3: What product attributes and quality marks can be incentives for consumers to choose plant-based BMS over conventional cows' milk BMS?

Table 5:
Research Variables and Statistical Test for sub-question 3.

INDEPENDENT VARIABLE	DEPENDENT VARIABLE	DATA ANALYSIS
Q11 (likelihood of purchasing plant-based infant formula) Target group for data analysis: Consumers that scored 4 or higher	Q7 (Importance of product attributes)	Friedman Which product attribute scored the highest in importance for the target group?
Q11 (likelihood of purchasing plant-based infant formula) Target group for data analysis: Consumers that scored 4 or higher	Q8 (Importance of quality marks)	Friedman Which quality marks scored the highest in importance for the target group?

SUB-QUESTION 4: What factors prevent consumers from choosing plant-based BMS over conventional cows' milk BMS?

Table 6:
Research Variables and Statistical Test for sub-question 4.

INDEPENDENT VARIABLE	DEPENDENT VARIABLE	DATA ANALYSIS
Q11 (likelihood of purchasing plant-based infant formula) Target group for data analysis: Consumers that scored 2 or lower	Q10 (Misconceptions of plant-based BMS)	Analyse which misconceptions are more likely to be considered true for consumers that scored 2 or lower in Q10: which misconceptions are the most popular (have a higher count of responders selecting 'true'?)

3. Results

The survey conducted among Italian parents received a total of 63 responses, surpassing the initial expectation of 30-50. This overview of the research results provides a summary of the key findings based on 60 valid responses, as 3 responses were excluded due to the participants not having children nor expecting a child.

The survey was distributed to the target group by using different approaches. The channels utilized for data collection included word-of-mouth, online forums, targeted Facebook groups, as well as encounters in public spaces such as trains, supermarkets, and workplaces. This approach aimed to maximize the survey's reach and capture a wide range of perspectives.

An important factor to consider is that only one male respondent participated in the survey, indicating a predominantly female perspective on the topic. Moreover, the number of respondents belonging to the research target group (parents of children aged 4 or under) amounts at 47.

Most of the survey respondents follow an omnivore diet (63%), while the number of vegetarian and vegan participants only amounts at 8 and 4 respectively. Furthermore, only 9 respondents out of 60 had previous experience using plant-based BMS, forecasting a niche market for such products in Italy.

Further information on the demographics of the survey respondents is displayed in the following chapters.

3.1 Sub-question 1: Impact of Demographic Factors

The survey results presented in this chapter examine the correlation between parents' preference for plant-based infant formula over cow's milk and six distinct demographic factors: gender, parental status, number of incomes, diet, experience with infant formula (BMS), and experience with plant-based BMS.

The first analysis of demographic factors influencing parents and caregivers' choice in regard to infant formula was conducted on the gender of the 60 responders.

The sample group is composed by 59 females and only 1 male. Therefore, a Mann-Whitney statistical test was not feasible due to the severe imbalance in sample sizes.

However, the average likelihood of choosing plant-based infant formula was calculated for females, where the dependent variable is a 5-point Likert scale. As displayed in Table 7, the average likelihood (on a scale from 1 to 5) of choosing plant-based formula among the female participants was 2.66, while the likelihood from the one male participant was 4.0. On this scale, 2 meant 'unlikely' and 3 meant 'neutral'* meaning that many females are tendentially unlikely to choose for plant based infant formula.

*Q11 Likert-scale: 1= very unlikely, 2= unlikely, 3= neutral, 4= likely, 5= very likely

Table 7:
Survey and Statistical Results for Sub-question 1 (gender)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE	
Q1 (Gender)		Q11 (likelihood of purchasing plant-based infant formula)	
n = Female	59	'Female' average*	2,66

As displayed in Table 8, the survey results emerging from the demographic analysis of parents with diverse parental statuses unveiled a notable trend of reluctance among the target group (parents with children aged 4 or under) when it comes to opting for plant-based infant formula. This sentiment was reflected in the research target group's average score of 2.47 on a 5-point Likert scale. Furthermore, the collective average likelihood of all 60 respondents tallies at 2.68, underscoring that parental scepticism towards these products extends beyond the research target group.

Among the demographics surveyed, expectant parents and caregivers emerged as the most inclined group to choose plant-based infant formula, boasting an average likelihood rating of 4 out of 5 on the Likert scale.

Table 8:
Survey Results for Sub-question 1 (parental status)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q2 (parental status)		Q11 (likelihood of purchasing plant-based infant formula)		Average likelihood (Q11) of target group
n = Expecting	5	'Expecting' average*	4,00	Target group for data analysis: Consumers with children aged 4 or under
n = Children aged 4 or under	47	' Children 4 or under ' average*	2,47	Target group average: 2,47
n = Children older than 4	15	'Children older than 4' average*	2,73	

Moreover, based on the demographic analysis of different income groups, the highest average likelihood (4.00 out of 5) of choosing plant-based infant formula was observed in parents/caregivers with more than 2 incomes or a special financial situation, while respondents with one single income displayed the lowest likelihood (2.25).

Based on the survey data set (sample) displayed in Table 9 and analysed using Kruskal Wallis test (Statistic: 2.575, df: 2, p-value: 0.276), no significant difference was found between different income groups, compared to a reference significance level of 0.05.

Table 9:
Survey and Statistical Results for Sub-question 1 (number of incomes)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q3 (number of incomes)		Q11 (likelihood of purchasing plant-based infant formula)		Kruskal Wallis
n = One income	12	'One income' average*	2,25	Statistic: 2.575
n = Two incomes	44	'Two incomes' average*	2,68	Degree of Freedom (df): 2
n = Other	4	'Other' average*	4,00	p-value: 0.276 (Reference significant level: 0.05) No significant difference between groups

Furthermore, through a categorisation of independent groups based on diet, the highest average likelihood of choosing plant-based infant formula was observed in the group composed by parents and caregivers that follow a vegan diet (average likelihood = 5,00 out of 5). The lowest likelihood of choosing plant-based infant formula (2.16 on a 5-point Likert scale) was observed among omnivore respondents. Flexitarian consumers are the second most likely to choose plant-based infant formula, with a mean likelihood of 3,60 out of 5, surpassing vegetarians (2,88 out of 5).

Based on the survey data displayed in Table 10 and analysed using the Kruskal Wallis test (Statistic: 15.965, df: 3, p-value: 0.001), significant differences were found between groups following different types of diets. These results suggest that the choice of plant-based infant formula varies significantly among consumers following different diets, warranting further investigation to understand how dietary choices of parents and caregivers' diet influence their perception of plant-based BMS for their children. There is a notable difference of 2.84 points on the Likert scale between the mean likelihoods of omnivore and vegan parents.

Table 10:
Survey and Statistical Results for Sub-question 1 (type of diet)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q4 (type of diet)		Q11 (likelihood of purchasing plant-based infant formula)		Kruskal Wallis
n = Omnivore	38	'Omnivore' average*	2,16	Statistic: 15.965
n = Flexitarian	10	'Flexitarian' average*	3,60	Degree of Freedom (df): 3
n = Vegetarian	8	'Vegetarian' average*	2,88	<p>p-value: 0.001 (Reference significant level: 0.05) There are significant differences between the groups</p>
n = Vegan	4	'Vegan' average*	5,00	
n = Religious Diet	0			

Subsequently, an analysis was conducted on the effects of parents' prior experience with infant formula in relation to their likelihood of choosing plant-based BMS.

the group of parents/caregivers with no experience using infant formula exhibited the highest average likelihood (3.18 out of 5) of choosing plant-based BMS. Conversely, respondents who exclusively used infant formula (without combining with breastfeeding) had the lowest likelihood (1.87) of choosing plant-based BMS.

Based on the survey data displayed in Table 11 and analysed using Kruskal Wallis test (Statistic: 6.291, df: 2, p-value: 0.043), significant differences were found between groups with different levels of experience using breastmilk substitutes. The mean likelihoods of parents with no experience using BMS and those who have used it exclusively differs by 1,31 points on the Likert scale. These findings indicate a clear association between experience with infant formula and preferences for plant-based options.

Table 11:
Survey and Statistical Results for Sub-question 1 (experience using BMS)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q5 (experience using BMS)		Q11 (likelihood of purchasing plant-based infant formula)		Kruskal Wallis
n = Exclusively	15	'Exclusively' average*	1,87	Statistic: 6.291
n = In combination with breastfeeding	28	'In combination with breastfeeding' average*	2,82	Degree of Freedom (df): 2
n = No experience	17	'No experience' average*	3,18	p-value: 0.043 (Reference significant level: 0.05) <i>There are significant differences between the groups</i>

Lastly, considering respondents' previous experience using plant-based BMS, it was not possible to execute the Kruskal Wallis test on the data, as this test requires the analysis of 3 independent groups. The 'Exclusively' group in the sample data is represented by only 1 response, meaning it cannot be utilised in the Kruskal Wallis test. Therefore, a Mann-Whitney test was executed instead, on the two remaining groups.

The group of consumers with experience using plant-based infant formula in combination with other methods displayed the highest average likelihood (3.40 out of 5) of choosing plant-based formula. In contrast, respondents with no prior experience had the lowest likelihood (2.57), differing of 0,83 points on the Likert scale.

The results of the Mann-Whitney test are displayed in Table 12. Based on the survey data analysed using the Mann-Whitney test (Statistic: 6.291, p-value: 0.053), no significant differences were found between the two analysed groups.

Table 12:
Survey and Statistical Results for Sub-question 1 (experience using plant-based BMS)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q6 (experience using plant-based BMS)		Q11 (likelihood of purchasing plant-based infant formula)		Mann-Whitney (2 independent groups)
n = Exclusively	1	'Exclusively' average*	3,00	Statistic: 99.000 p-value: 0.053 (Reference significant level: 0.05) No significant difference between groups
n = In combination with breastfeeding / other types of BMS	8	'In combination with breastfeeding / other types of BMS' average*	3,40	
n = No experience	51	No experience average*	2,57	

3.2 Sub-question 2: Preferred Plant-Based Ingredient for BMS

Out of the 60 responders, 43 belong to the target group for this data analysis, which is parents and caregivers with previous experience using BMS. Consumers with no experience using BMS can only hypothetically determine which base-ingredient is the most preferred.

Animal-derived ingredients were included as an option in the survey, to assess their prevalence in the Italian market in comparison to plant-based BMS ingredients.

As displayed in Table 13, the most favoured base-ingredient is cow's milk, garnering significant support from 28 respondents, representing 65 percent of the target group.

Hydrolysed Milk Proteins secured the second spot with 8 responders, accounting for 19 percent of the sample group. Coming in at third place are Hydrolysed Vegetable Proteins, chosen by 3 responders, making up 7 percent of the sample group and representing the

most preferred plant-based ingredient for consumers in the Italian market. Additionally, a small percentage of the group indicated preferences for alternative options, including Oat, Soy, Almond, and Rice, each receiving 1 response, each equivalent to 2 percent of the sample group.

Table 13:
Survey and Statistical Results for Sub-question 2 (preferred BMS base-ingredient)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q5 (experience using BMS)		Q9 (Preferred BMS base-ingredient)		Target Group's Most Preferred Base-Ingredient
n = Exclusively	15	Cow's Milk	28	Target group for data analysis: Consumers with previous experience with BMS Most favoured base-ingredient rank: 1. Cow's milk 2. Hydrolised Milk Proteins 3. Hydrolysed Vegetable Proteins Other: Oat, Soy, Almond, Rice
n = In combination with breastfeeding	28	Hydrolyzed Milk Proteins	8	
n = No experience	17	Hydrolyzed Vegetable Proteins	3	
		Oat Soy Almond Rice	1	
		Soy	1	
		Almond	1	
		Rice	1	

3.3 Sub-question 3: The Importance of Product Attributes and Quality Marks

The Friedman test was conducted on five independent groups, each based on a 1 to 5 likelihood score of choosing infant formula (Q11). The test aimed to ascertain whether significant differences existed between these groups concerning their importance attribution to six product attributes.

Analysing the product attribute scores from the target group responders (consumers that scored 4 or 5 on the Likert scale), it is evident that 'Specific Nutritional Claims' were ranked as the most important attribute, with an average score of 4.50. Following this, Availability and Medical Advice were also perceived as highly important attributes, with average scores of 4.17 and 4.11, respectively. Meanwhile, Price, Format, and Previous Experience received lower average scores, ranging from 3.29 to 3.94.

As displayed in Table 14, the results of the Friedman test indicate a chi-squared value of 42.194 with 4 degrees of freedom and a p-value of less than .001, signifying that there are indeed significant differences between the groups regarding their perceptions of the product attributes.

This implies that parents who are likely to choose plant-based BMS consider certain products attributes more or less important, compared to parents and caregivers that are unlikely to choose plant-based BMS.

Table 14:
Survey and Statistical Results for Sub-question 3 (importance of product attributes)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q11 (likelihood of purchasing plant-based infant formula)		Q7 (Product Attributes)		Friedman
Very Unlikely	16	Price (Target Group average)	3,29	Which product attribute scored the highest in importance for the target group?
Unlikely	14	Format (Target Group average)	3,35	Target group for data analysis: Consumers that scored 4 or higher in Q10
Neutral	13	Medical Advice (Target Group average)	4,11	Chi-squared: 42.194

Likely	7	Availability (Target Group average)	4,17	Degree of Freedom (df): 4
Very Likely	10	Previous Experience (Target Group average)	3,94	p-value: < .001 (Reference significant level: 0.05) <i>There are significant differences between the groups</i>
		Specific Nutritional Claims (Target Group average)	4,50	

Subsequently, the Friedman test was conducted on the same five groups, each based on a 1 to 5 likelihood score of choosing infant formula, to assess whether there were significant differences between the groups regarding the importance they attributed to four different quality marks.

by analysing the quality mark scores from the target group responders (consumers that scored 4 or 5 on the Likert scale), it appears that "Organic" was ranked as the most important attribute, with an average score of 4.12. Following this, "Dairy Free" received a close average score of 4.06 within the target group, while "Fortified with Nutrients" and "Vegan" obtained lower average scores of 3.88 and 3.59, respectively.

Based on these findings, it seems that the target group places a relatively higher importance on the "Organic" and "Dairy Free" quality marks, followed closely by the "Fortified with Nutrients" attribute. However, it's important to note that the overall differences in importance among these quality marks were not statistically significant, as indicated by the Friedman test results in Table 15.

Table 15 presents the results of the Friedman test, computing a chi-squared value of 1.907 with 4 degrees of freedom and a p-value of 0.592. These results indicate that there are no significant differences between the groups in their perceptions of the importance of the quality marks.

Table 15:
Survey and Statistical Results for Sub-question 3 (importance of quality marks)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q11 (likelihood of purchasing plant-based infant formula)		Q8 (Quality Marks)		Friedman
Very Unlikely	16	Organic (Target Group average)	4,12	Which quality mark scored the highest in importance for the target group?
Unlikely	14	Dairy Free (Target Group average)	4,06	Target group for data analysis: Consumers that scored 4 or higher in Q10
Neutral	13	Fortified (Target Group average)	3,88	Chi-squared: 1.907
Likely	7	Vegan (Target Group average)	3,59	Degree of Freedom (df): 4
Very Likely	10			p-value: 0.592 (Reference significant level: 0.05) No significant difference between groups

3.4 Sub-question 4: Misconceptions and Drawbacks related to Plant-Based BMS

The data analysis included five groups of parents, who were divided into groups based on a scale of 1 to 5 of their likelihood of choosing plant-based infant formula. Out of the total 60 responders, 30 belonged to the target group (consumers that scored 2 or 1 on the Likert scale), indicating a 50% representation.

The target group participants were asked to respond to affirmations regarding plant-based diets in children, indicating whether they believe them to be true, false, or were uncertain due to a lack of information.

By analysing the responses from the target group, it became evident that the most prevalent misconceptions revolve around the affirmations "Not recommended by doctors" and "Not safe for children development," with 12 and 11 participants, respectively, selecting "true" for these statements. Conversely, the affirmations "Nutritionally Incomplete" and "Hard to Find Plant-based Substitutes" garnered relatively fewer "true" responses, with 8 and 5 participants, respectively. Moreover, only 1 participant agreed with the statement "Bad taste/Rejected."

These findings, displayed in Table 16, suggest that among parents unlikely to choose plant-based infant formula, there is a prominent misperception that doctors do not recommend such formulas and have concerns about their safety for children's development.

Table 16:
Survey and Statistical Results for Sub-question 4 (Misconceptions and Drawbacks)

INDEPENDENT VARIABLE		DEPENDENT VARIABLE		STATISTICAL TEST
Q11 (likelihood of purchasing plant-based infant formula)		Q10 (Misconceptions considered as TRUE)		Target Group's Most Common Misconception/Drawback
Very Unlikely	16	Nutritionally Incomplete	8	Target group for data analysis: Consumers that scored 2 or lower in Q10
Unlikely	14	Not Safe for Children Development	11	Most common drawback/misconception: 1. Not recommended by doctors 2. Not safe in age of development 3. Nutritionally Incomplete 4. Hard to find plant-based substitutes 5. Bad taste
Neutral	13	Hard to Find Plant-based Substitutes	5	
Likely	7	Bad taste/Rejected	1	
Very Likely	10	Not recommended by doctors	12	

4. Discussion of Results

The research aimed to explore the main factors influencing Italian parents and caregivers when choosing between plant-based and conventional cows' milk infant formula. The objective of this research was to find out whether there is a positive or negative attitude among Italian consumers towards plant-based infant formula for infants.

The following chapter includes a reflection on the methodology utilised in this study, as well as a discussion of the results emerged from the consumer survey.

4.1 Reflection on Methodology

Because of the specificity of the research target group, collecting responses from a proportionate sample population posed a challenge. This complication can be noticed especially in the gender imbalance within the responses. Furthermore, there is a lack of information on the age and residential location of the respondents, which may also be demographic factors of significant influence.

Despite these complications, enough data was collected, allowing for a statistical analysis of the dataset to identify correlations between variables and provide additional evidence that supports existing research on the topic.

Moreover, the methodology employed in this research involved formulating survey questions under the premise of assuming all parents and caregivers in Italy possessed comprehensive knowledge about breastmilk substitutes. However, it was acknowledged that parents unfamiliar with such products might struggle to articulate preferences and opinions on the topic. Plant-based breastmilk substitutes, being niche in the Italian market, may have not been contemplated as a feasible alternative to cows' milk BMS. Additionally, the lack of awareness about associated environmental, health, and social issues often leads to choices based on convenience rather than informed decision-making. Further investigation is warranted in this area to precisely target the demographic interested in plant-based breastmilk substitutes. The selected sample should comprise parents of young children who possess prior understanding of infant nutrition and are informed about the environmental and societal implications associated with traditional cow's milk-based breastmilk substitutes.

4.2 Likelihood of Italian Parents of Choosing Plant-Based Infant Formula

The mean likelihood score for choosing plant-based BMS among all 60 survey respondents was 2.68, as measured on a 5-point Likert scale. This suggests a prevailing sense of hesitation among average Italian parents regarding these alternatives.

A deeper inquiry is needed to underline the reasons behind this scepticism and hesitation among Italian parents and caregivers. This exploration aims to assist the infant nutrition industry in addressing prevalent concerns and misunderstandings regarding plant-based infant formula. The ultimate goal is to foster a more positive outlook among parents and caregivers, promoting greater acceptance of plant-based BMS.

To better answer the main research question, a discussion of the four sub-questions is needed to individually analyse the factors impacting and differentiating parents' choice, and the underlying reasons for their hesitancy.

In the following sections, the results for each sub-question will be discussed.

4.3 Impact of Demographic Factors

The first research sub-question aimed to explore the main demographic factors influencing parents and caregivers when choosing between plant-based and conventional cows' milk infant formula. The literature research conducted on the topic highlighted the significance of gender, age, urban living, income level, diet, and cultural or religious beliefs as potential influencers in choosing plant-based alternatives for infant nutrition (Fehér et al., 2020).

The survey data set highlighted a significant gender imbalance, with only one male respondent, leading to a predominantly female perspective on the topic. This outcome may suggest that mothers and female caregivers are, in many Italian households, the main decision-maker for their children's diet and nutrition.

As stated in Chapter 1.7, the research conducted by Modlinska et al. (2020) has demonstrated that the perception of animal protein consumption as a masculine trait is associated with lower adoption of plant-based diets among men (Modlinska et al., 2020). Conversely, women are more likely to have positive perceptions of plant-based diets and adopt them in adulthood (Modlinska et al., 2020)

Because of the low representation of males in the survey sample group, it was not possible to conduct a Mann-Whitney statistical test. This implies that a proper comparison between the likelihood of choosing plant-based BMS of male and female respondents was not possible.

Nevertheless, the survey results show a relative hesitancy in Italian females towards choosing plant-based infant formula, as indicated by their average likelihood score of 2.66 on the 5-point Likert scale. Additional research is essential to explore how gender might influence parents' dietary decisions for their children. Providing educational initiatives for both mothers and fathers could play a pivotal role in expanding their perspectives, empowering them to make well-informed and deliberate dietary choices for their children.

The analysis on the sample group's parental status revealed interesting findings, with expectant parents and caregivers displaying the highest average likelihood (4 out of 5) of choosing plant-based infant formula. This may suggest that individuals who are preparing to become parents are more open to consider plant-based options for their children, while people with children tend to make this decision based on an assertion of the child's and mother's tangible needs.

The findings indicate there is a perceptible willingness in expectant parents to select plant-based infant formula, which should be perceived as a more environment-friendly option (Poore & Nemecek, 2018). However, external factors - such availability in commercial stores, affordability, doctor's recommendation, or easy access to the product - intrinsically influence their choice once the needs of the child become tangible (Fehér et al., 2020). This highlights the necessity of making plant-based BMS more accessible and affordable for parents to better ensure their freedom of choice and accommodate their positive intentions of choosing environment-friendly options.

Moreover, expectant parents are expected to fit into a younger age group compared to parents with children over 4 years of age. This factor should be taken into consideration when comparing these results to Fehér et al.'s research (2020), stating that younger consumers tend to prioritize environmental sustainability and animal welfare, which are key drivers for the adoption of plant-based diets (Fehér et al., 2020).

Following an analysis of the financial circumstances of Italian families, the study determined that the number of incomes within households in Italy does not exhibit statistically significant influence over parents' choices regarding plant-based infant formula. These results contradict the findings of the research conducted by Fehér et al. (2020), where income was identified as a significant factor impacting such decisions (Fehér et al., 2020)

However, the analysis on the sample group showed that parents and caregivers with more than two incomes or with a special financial situation showed the highest average likelihood of choosing plant-based infant formula. Conversely, respondents with a single income displayed the lowest likelihood. This data suggests that families with limited income often opt for the most financially viable choices available in the market, which currently include cow's milk-based breastmilk substitutes (Fortune Business Insights,

2020). These findings underscore the importance of enhancing the accessibility and affordability of plant-based breastmilk substitutes for Italian parents to enable single-income families and those facing financial constraints to consider plant-based options when making their choices.

In alignment with the findings of the research by Fehér et al. (2020), parents' and caregivers' diet significantly impacted the preference for plant-based options for children (Fehér et al., 2020). In fact, the significant difference between groups was statistically proven through the use of the Kruskal Wallis test.

Within the survey sample group, vegan parents and caregivers had the highest average likelihood of choosing plant-based infant formula, while omnivore respondents displayed the lowest likelihood. This data supports existing research on the topic and demonstrates how the diet and lifestyle of parents' and caregivers is often directly projected onto their children. This suggests that, in parallel to the growing number of families choosing to adopt a predominantly plant-based diet, there may be a significant market opportunity for the growth of plant-based infant nutrition.

An intriguing discovery emerging from the examination of dietary influences is that flexitarian consumers exhibit a higher inclination towards selecting plant-based BMS in contrast to vegetarian consumers. To comprehensively understand the underlying reasons for this observation, additional research is imperative to construct a well-founded explanation. One potential rationale could be that vegetarians, who eliminate meat and fish from their diets, often rely heavily on dairy as a primary source of nutrition and protein. Consequently, their perception of cow's milk formula might lean towards a more positive outlook.

The Kruskal Wallis test was also conducted by taking into consideration the previous experience of parents and caregivers with breastmilk substitutes. A significant difference in likelihood of choosing plant-based BMS was observed in parents with different levels of experience using these products. The impact of parents' previous experience in relation to breastmilk substitutes has not yet been thoroughly researched and investigated as a factor of influence in their product selection. Consequently, a meaningful comparison of these research findings with existing literature is currently not feasible.

Within the sample group, parents with no experience using BMS scored the highest average likelihood (3,18 out of 5) of choosing plant-based BMS, in contrast to parents with experience using BMS exclusively, which only scored an average likelihood of 1,87.

This may suggest that there is often a good intention in parents and caregivers in choosing more sustainable options to feed their children. However, when the choice isn't hypothetical, there may be several drawbacks that prevent parents and caregivers from choosing plant-based BMS (Fehér et al., 2020). Moreover, the difference in likelihood of

choosing plant-based BMS may also be affected by whether the product is used exclusively or in combination with breastfeeding. In fact, when used exclusively, parents may have higher concerns on whether the product provides sufficient nourishment to the infant, leading them to select an animal-derived base-ingredient as a first choice.

These results indicate that demographic factors play a significant role in parents and caregivers' preferences for infant formula. However, the demographic factors that were statistically proven to be influential emphasize the importance of conducting more comprehensive research with a balanced sample group, to gain deeper insights into the factors shaping these choices. Additionally, understanding the underlying reasons for hesitancy or openness towards plant-based options can aid in designing targeted educational efforts and interventions to promote healthier and sustainable nutrition practices for infants.

4.4 Preferred plant-based ingredient for BMS

The research question sought to determine the most preferred base-ingredient for plant-based breastmilk substitutes among parents with previous experience using infant formula.

Given the diverse levels of experience within the research sample group regarding plant-based breastmilk substitutes, the survey question was designed to encompass both plant-based and animal-derived ingredient options. This accommodated parents with prior exposure to plant-based infant formula, who are experienced enough to identify the most effective plant-based ingredient for infant formula according to their needs. Conversely, parents without such experience lack the ability to assess the nutritional suitability of different plant-based ingredients. This strategy was also employed to enable a direct comparison between the prevalence of cow's milk formula and plant-based alternatives in the Italian market. This decision is rooted in previous research on the infant nutrition market, revealing that plant-based breastmilk substitutes constitute only 0.4 percent of the overall infant formula market share (Fortune Business Insights, 2020). The survey results reveal that cow's milk remains the most favoured base-ingredient in the Italian market, with 65 percent of the target group respondents selecting it as their preference. Hydrolysed Milk Proteins secured the second spot with 19 percent, while Hydrolysed Vegetable Proteins ranked third with 7 percent, meaning that these are the most preferred plant-based ingredient for plant-based BMS within the target group. Alternative options such as Oat, Soy, Almond, and Rice received smaller percentages of 2 percent each.

Literature research indicates that cow's milk, commonly used in breastmilk substitutes, can lead to milk allergy in a small percentage of infants and young children worldwide (Martin et al., 2016). To address this, specialty infant formulas incorporate a mix of alternative sources, such as soy and rice (Verduci et al., 2019). Soy-based formulas are suitable for infants with cow's milk allergy but may not be recommended for allergy-prone infants due to soy's allergenic nature (Verduci et al., 2019). Rice-based formulas, including hydrolysed rice proteins, have been developed as hypoallergenic alternatives, supplemented to ensure nutritional adequacy (Verduci et al., 2019).

The findings from the survey data align with the literature research, indicating that while hydrolysed vegetable proteins are the most favoured base-ingredient for plant-based infant formula, cow's milk still remains the top choice among the target group (Fortune Business Insights, 2020).

The synthesis of literature research and survey findings advocates that manufacturers of plant-based infant formula should prioritize the development of anti-allergenic and highly digestible vegan products, by including a mix of different plant sources. Achieving this goal necessitates the utilization of a blend of hydrolysed proteins, rather than solely focusing on a singular protein source.

These results are crucial for the industry to understand the preferences of the target group and develop products that cater to their needs while also considering allergenic concerns and ensuring adequate nutritional profiles for infant health.

4.5 The Importance of Product Attributes and Quality Marks

The third sub-question sought to identify the product attributes and quality marks that incentivize consumers to choose plant-based breastmilk substitutes (BMS) over conventional cows' milk BMS. The analysis was focused on a target group of consumers who are likely to choose plant-based infant formula, based on their high likelihood scores (4 or higher) on a 5-point Likert scale.

From the literature research, it is evident that parents prioritize certain attributes when selecting infant formula, such as the presence of DHA, organic certification, and digestibility (Altmann & Hill, 2021). Moreover, concerns surrounding nutrient deficiencies, limited food choices, social stigma, and perceived difficulties in meeting dietary needs may contribute to parents' hesitancy in adopting a plant-based diet for their children (Bivi et al., 2021).

The results of the Friedman test for product attributes demonstrated significant differences between the consumer groups, indicating that parents that are likely to choose plant-based BMS attributed varying levels of importance to different product attributes, compared to parents unlikely to choose plant-based BMS. Among the target group respondents, "Specific Nutritional Claims" emerged as the most important attribute, followed by "Medical Advice" and "Availability." In contrast, "Price," "Format," and "Previous Experience" were considered less important by the target group.

However, when analysing the quality mark scores, the Friedman test showed no significant differences between the groups. The target group placed relatively higher importance on "Organic" and "Dairy Free" quality marks, while "Fortified" and "Vegan" marks received lower importance scores. Despite these differences in importance, the statistical test did not indicate any significant disparities between the groups.

The findings indicate that clearly stated nutritional claims on the packaging of plant-based infant formula, supported by medical recommendations, have the potential to sway a greater number of parents and caregivers towards selecting the plant-based option. Furthermore, the convenient availability of this product in supermarkets and pharmacies holds significant importance for consumers within the target group.

Moreover, as the target group displays a predisposition towards selecting plant-based formula, it becomes essential to ensure the product's exclusion of dairy milk to meet their needs. Additionally, these parents emphasize the organic nature of the product, directing attention towards the methods employed in producing plant-based ingredients. The "Vegan" quality mark received comparatively lower significance, possibly signifying that the target group already finds enough satisfaction in the product's dairy-free composition. While certain additions to the product may have animal origins (e.g., Vitamin D3), they are typically present in minimal quantities, resulting in a smaller environmental impact.

The findings highlight the significance of specific product attributes and quality marks in influencing parents' decisions to opt for plant-based BMS. Understanding these preferences can aid manufacturers in tailoring their products to meet consumer demands and improve overall acceptance of plant-based alternatives.

4.6 Misconceptions and Drawbacks related to Plant-Based BMS

This research sub-question aimed to identify the misconceptions and drawbacks that hinder consumers from choosing plant-based breastmilk substitutes (BMS) over conventional cows' milk BMS for their children. Out of the 60 respondents, 30 belonged to the target group, represented by consumers that are least likely to opt for plant-based formula, indicating a representative 50% of the sample.

The analysis of the target group's responses revealed several noteworthy findings. The most prevalent misconceptions were related to the affirmations "Not recommended by doctors" and "Not safe for children development," with 12 and 11 participants, respectively, selecting "true" for these statements. These findings suggest that parents in the target group hold a significant perception that doctors do not endorse plant-based diets and have concerns about their safety for children's development.

These findings are in alignment with the research conducted by Bivi et al. (2021), where it is stated that communication barriers with primary care paediatricians are a source of apprehension for many vegan parents (Bivi et al., 2021). The study also revealed that more than 70 percent of primary care paediatricians were perceived as sceptical or against a vegan diet for children, often due to popular misconceptions or outdated scientific research (Bivi et al., 2021). The alignment of our survey results with the research conducted by Bivi et al. (2021) underscores the necessity of educating and keeping doctors and paediatricians updated on the safety of plant-based diets for children. This ensures that parents and caregivers receive more informed guidance regarding the dietary choices and nutritional practices of the family.

In contrast, relatively fewer participants of the survey agreed with affirmations like "Nutritionally Incomplete" and "Hard to Find Plant-based Substitutes".

The research results partially align with existing literature on the topic, which emphasizes the factors contributing to parents' hesitations in embracing plant-based diets for their families. Concerns about nutrient deficiencies, limited food choices, social stigma, and challenges in meeting dietary needs are cited as reasons for their reluctance (Bivi et al., 2021).

The study provides valuable insights into the specific misconceptions prevalent among Italian parents that are not likely to choose plant-based BMS, helping to shed light on areas where targeted education and communication efforts can be directed. By addressing these misconceptions and providing accurate information about the nutritional adequacy and safety of plant-based diets for children, the research results could contribute to fostering more informed decisions among parents and medical professionals when it comes to selecting infant formula options.

5. Conclusions and Recommendations

5.1 Conclusions

This research explored Italian parents' willingness to use plant-based breastmilk substitutes (BMS) for their children, uncovering influential factors in consumers' decision-making process. Targeted efforts can address concerns and promote plant-based BMS adoption in Italy, which could mitigate the negative environmental impact of traditional cow's BMS and address healthcare issues such as food allergies in infants.

The survey results revealed an overall hesitancy among Italian parents of choosing plant-based infant formula. This suggests that Italian parents may have reservations or uncertainties about adopting plant-based alternatives for infant nutrition. The key takeaway from these findings is the necessity to foster a more positive outlook among Italian parents and caregivers, promoting greater acceptance and adoption of plant-based BMS.

Additionally, the results shed light on influential demographic factors. Expectant parents were more open to plant-based formula compared to parents with children, indicating a positive intention among parents who are yet to assess their children's tangible needs. Household income didn't statistically affect decisions, but multi-income families favoured plant-based options, while single-income families opted for more affordable choices. These results underscore the need to make plant-based BMS prices more competitive in comparison to traditional cow's milk-based infant formulas.

As anticipated, vegan parents showed a preference for plant-based BMS, while omnivores displayed more scepticism, indicating that parental dietary choices often extend to their children. These findings indicate a market growth opportunity for plant-based BMS, as more families adopt predominantly plant-based diets.

Parents' previous experience with infant formula also mattered, with those without prior experience being more likely to choose plant-based BMS.

Among formula-experienced parents, cow's milk remained the preferred base ingredient for plant-based BMS, while Hydrolysed Vegetable Proteins emerged as the most preferred plant-based ingredient, chosen by only 7 percent of all survey respondents, followed by oats, soy, almond, and rice.

Furthermore, parents inclined to choose plant-based BMS favoured the presence of nutritional claims backed by medical advice and valued product availability in commercial stores and pharmacies. Attributes like "Dairy Free," "Organic," and "Fortified with Nutrients," indicated on the product packaging, were highly important for these parents. The most common concerns among parents less likely to opt for plant-based formula included apprehensions about doctor recommendations and child development safety.

5.2 Recommendations

Based on the findings drawn from this research study, the following recommendations are formulated to encourage the adoption of plant-based breastmilk substitutes (BMS) among the target group of Italian parents.

The following recommendations offer solutions for short-term outcomes:

- **Conduct Follow-Up Research:** Academic and research Institutions, healthcare professionals and government health agencies are advised to conduct follow-up research to explore other potential influencers affecting parents' choices in infant nutrition. This could involve larger sample sizes, more diverse respondent groups, and repeated surveys over time to identify trends and changes in attitudes towards plant-based breastmilk substitutes.
- **Collaborate with Healthcare Professionals:** Manufacturers in the infant nutrition industry should engage and collaborate with healthcare providers, including paediatricians and family doctors, in promoting plant-based BMS as a viable and safe alternative. This could include the organisation of workshops and seminars to update healthcare professionals on the latest research and guidelines related to plant-based infant nutrition and encourage open discussions addressing concerns and reservations parents and doctors may have.
- **Improve Availability and Affordability:** Manufacturers and industry stakeholders play a pivotal role in ensuring that plant-based BMS is not only accessible to a wider demographic but also financially feasible for parents and caregivers. Manufacturers and industry stakeholders are advised to ensure better accessibility and affordability of plant-based BMS in the market. This could involve collaborating with governments and investors to create subsidies or incentives for plant-based formula production and distribution, making it a more attractive option for parents.
- **Forge Collaborative Partnerships with Retailers:** It is highly advised that manufacturers establish close partnerships with commercial retailers (supermarkets and pharmacies) to enhance the visibility and prominence of plant-based BMS products on store shelves. Sharing data-backed insights, educational materials, and unique selling propositions specific to these products can effectively persuade retailers to recognize the significant market potential inherent in plant-based offerings. Additionally, manufacturers should emphasize the sustainability advantages of these products, underscoring their inclusion in periodical sustainability reports.

The following recommendations should be viewed as strategic investments for future benefits, grounded in a long-term perspective:

- **Targeted Education Campaigns:** Media outlets, online health platforms, and parenting support groups should think about launching comprehensive campaigns specifically designed to tackle the prevailing misconceptions surrounding plant-based nutrition in children. These initiatives should be focused on dispelling misconceptions that plant-based diets are "Not recommended by doctors" and "Not safe for children's development". The campaign's core objective should be to furnish evidence-based data, substantiating the safety and nutritional completeness of plant-based formulas and diets. By proactively addressing these concerns, parents can gain the knowledge and reassurance they need to make informed choices, fostering greater confidence in opting for plant-based BMS.
- **Diversify Plant-Based BMS with a Focus on Hydrolysed Vegetable Proteins:** Manufacturers should implement modern R&D and product development practices to expand their plant-based BMS portfolio, incorporating a blend of plant sources to accommodate diverse dietary preferences. Emphasize the inclusion of hydrolysed vegetable proteins as a preferred plant-based base ingredient, catering to both health-conscious consumers and infants with specific dietary needs, while providing a comprehensive and allergen-free formula option.
- **Address Social Stigma:** Public health organizations, by utilising updated scientific and medical research, should work on raising awareness about plant-based nutrition in children to combat social stigmas and misconceptions surrounding plant-based diets. Engaging and collaborating with nutrition and dietetics associations, media outlets, influencers, and public figures to promote the benefits of plant-based infant nutrition can create positive social narratives that demolish outdated misconceptions and beliefs about plant-based diets in children.

Reference List

- Altmann, T. R., & Hill, D. J. (2019). *Caring for Your Baby and Young Child: Birth to Age 5*. In *American Academy of Pediatrics eBooks*. <https://doi.org/10.1542/9781610023443>
- Andreas, N. J., Kampmann, B., & Mehring Le-Doare, K. (2015). Human breast milk: A review on its composition and bioactivity. *Early Human Development*, 91(11), 629–635. <https://doi.org/10.1016/j.earlhumdev.2015.08.013>
- Andresen, E., Hjelkrem, A. R., Bakken, A. K., & Andersen, L. F. (2022). Environmental Impact of Feeding with Infant Formula in Comparison with Breastfeeding. *International Journal of Environmental Research and Public Health*, 19(11), 6397. <https://doi.org/10.3390/ijerph19116397>
- Barennes, H., Empis, G., Quang, T. D., Sengkhomyong, K., Phasavath, P., Harimanana, A., Sambany, E. M., & Koffi, P. N. (2012). Breast-Milk Substitutes: A New Old-Threat for Breastfeeding Policy in Developing Countries. A Case Study in a Traditionally High Breastfeeding Country. *PLOS ONE*, 7(2), e30634. <https://doi.org/10.1371/journal.pone.0030634>
- Bivi, D., Di Chio, T., Geri, F., Morganti, R., Goggi, S., Baroni, L., Mumolo, M. G., De Bortoli, N., Peroni, D. G., Marchi, S., & Bellini, M. (2021). Raising Children on a Vegan Diet: Parents' Opinion on Problems in Everyday Life. *Nutrients*, 13(6), 1796. <https://doi.org/10.3390/nu13061796>

Brown, A., Raynor, P., & Lee, M. (2011). Healthcare professionals' and mothers' perceptions of factors that influence decisions to breastfeed or formula feed infants: a comparative study. *Journal of Advanced Nursing*, 67(9), 1993–2003. <https://doi.org/10.1111/j.1365-2648.2011.05647.x>

Data Bridge. (2022). Global Soy Milk Infant Formula Market : Industry Trends and Forecast to 2029. In *Data Bridge Market Research* (SKU-55750). Retrieved November 10, 2022, from <https://www.databridgemarketresearch.com/reports/global-soy-milk-infant-formula-market#>

European Parliament and Council. (2013, June 12). *EU Regulation 609/2013: Infant and follow-on formula — composition and information*. EUR-Lex. Retrieved December 8, 2022, from <https://eur-lex.europa.eu/EN/legal-content/summary/infant-and-follow-on-formula-composition-and-information.html>

Expert Market Research. (2021). *Global Soy-Based Infant Formula Market: By Application: 12-36 months, 6-12 months, 0-6 months; Regional Analysis; Historical Market and Forecast (2017-2027); Market Dynamics; SWOT Analysis; EMR's Key Indicators for Demand; EMR's Key Indicators for Price; Competitive Landscape; Industry Events and Developments*. Retrieved November 10, 2022, from <https://www.expertmarketresearch.com/about-us>

(FAO) Food and Agriculture Organisation of the United Nations. (2019). Greenhouse Gas Emissions from the Dairy Sector: A Life Cycle Assessment. In *FAO.org* (ISBN 978-92-5-131232-2). FAO. Retrieved November 3, 2022, from <https://www.fao.org/3/CA2929EN/ca2929en.pdf>

Fehér, A., Gazdecki, M., Véha, M., Szakály, M., & Szakály, Z. (2020). A Comprehensive Review of the Benefits of and the Barriers to the Switch to a Plant-Based Diet. *Sustainability*, 12(10), 4136. <https://doi.org/10.3390/su12104136>

Fiocchi, A., Brozek, J., Schünemann, H., Bahna, S. L., Von Berg, A., Beyer, K., Bozzola, M., Bradsher, J., Compalati, E., Ebisawa, M., Guzman, M. A., Li, H., Heine, R. G., Keith, P., Lack, G., Landi, M., Martelli, A., Rancé, F., Sampson, H., . . . Vieths, S. (2010). World Allergy Organization (WAO) Diagnosis and Rationale for Action against Cow's Milk Allergy (DRACMA) Guidelines. *World Allergy Organization Journal*, 3(4), 57–161. <https://doi.org/10.1097/wox.0b013e3181defeb9>

Fortune Business Insights. (2020, August). *Infant Formula Market Size 2020-2027*.

Retrieved December 9, 2022,

from <https://www.fortunebusinessinsights.com/industry-reports/infant-formula-market-101498>

ISTAT. (2021). Censimento Della Popolazione E Dinamica Demografica: Popolazione e Famiglie. In *Istat* (No. 264511). Retrieved June 10, 2023, from <https://www.istat.it/it/archivio/264511>

Karlsson, J. O., Garnett, T., Rollins, N. C., & Rööös, E. (2019). The carbon footprint of breastmilk substitutes in comparison with breastfeeding. *Journal of Cleaner Production*, 222, 436–445. <https://doi.org/10.1016/j.jclepro.2019.03.043>

Martin, C., Ling, P. R., & Blackburn, G. (2016). Review of Infant Feeding: Key Features of Breast Milk and Infant Formula. *Nutrients*, 8(5), 279. <https://doi.org/10.3390/nu8050279>

- Martín-Rodríguez, A., Bustamante-Sánchez, L., Martínez-Guardado, I., Navarro-Jiménez, E., Plata-SanJuan, E., Tornero-Aguilera, J. F., & Clemente-Suárez, V. J. (2022). Infancy Dietary Patterns, Development, and Health: An Extensive Narrative Review. *Children*, 9(7), 1072. <https://doi.org/10.3390/children9071072>
- Modlinska, K., Adamczyk, D., Maison, D., & Pisula, W. (2020). Gender Differences in Attitudes to Vegans/Vegetarians and Their Food Preferences, and Their Implications for Promoting Sustainable Dietary Patterns—A Systematic Review. *Sustainability*, 12(16), 6292. <https://doi.org/10.3390/su12166292>
- Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, 360(6392), 987–992. <https://doi.org/10.1126/science.aag0216>
- Pope, D., Karlsson, J., Baker, P. N., & McCoy, D. (2021). Examining the Environmental Impacts of the Dairy and Baby Food Industries: Are First-Food Systems a Crucial Missing Part of the Healthy and Sustainable Food Systems Agenda Now Underway? *International Journal of Environmental Research and Public Health*, 18(23), 12678. <https://doi.org/10.3390/ijerph182312678>
- Vandenplas, Y., Hegar, B., Munasir, Z., Astawan, M., Juffrie, M., Bardosono, S., Sekartini, R., Basrowi, R. W., & Wasito, E. (2021). The role of soy plant-based formula supplemented with dietary fiber to support children's growth and development: An expert opinion. *Nutrition*, 90, 111278. <https://doi.org/10.1016/j.nut.2021.111278>

- Vennemann, M., Bajanowski, T., Brinkmann, B., Jorch, G., Yücesan, K., Sauerland, C., & Mitchell, E. A. (2009). Does Breastfeeding Reduce the Risk of Sudden Infant Death Syndrome? *Pediatrics*, *123*(3), e406–e410. <https://doi.org/10.1542/peds.2008-2145>
- Verduci, E., D’Elios, S., Cerrato, L., Comberiati, P., Calvani, M., Palazzo, S., Martelli, A., Landi, M., Trikamjee, T., & Peroni, D. G. (2019). Cow’s Milk Substitutes for Children: Nutritional Aspects of Milk from Different Mammalian Species, Special Formula and Plant-Based Beverages. *Nutrients*, *11*(8), 1739. <https://doi.org/10.3390/nu11081739>
- Victora, C. G., Bahl, R., Barros, A. J. D., França, G. V. A., Horton, S., Krasevec, J., Murch, S., Sankar, M. J., Walker, N., & Rollins, N. C. (2016). Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *The Lancet*, *387*(10017), 475–490. [https://doi.org/10.1016/s0140-6736\(15\)01024-7](https://doi.org/10.1016/s0140-6736(15)01024-7)
- Westmark, C. J. (2017). Soy-Based Therapeutic Baby Formulas: Testable Hypotheses Regarding the Pros and Cons. *Frontiers in Nutrition*, *3*. <https://doi.org/10.3389/fnut.2016.00059>
- (WHO) World Health Organisation. (2021, June 9). *Infant and Young Child Feeding*. WHO.int. Retrieved November 3, 2022, from <https://www.who.int/news-room/fact-sheets/detail/infant-and-young-child-feeding>

Appendix 1: Consumer Survey (English)

Section 1: Information on the consumer

1. What is your gender?

- Male
- Female
- I prefer not to respond

2. What is your parental status? *(Multiple may apply)*

- I do not have children
- I am expecting a child
- I have children aged 4 or under
- I have children over 4 years of age

3. How many sources of income are present in your household?

- One Income
- Two Incomes
- More than two incomes / Special financial situation

4. Which of the following categories best describes your diet?

- Omnivore (I regularly include meat, fish, dairy and eggs in my diet)
- Flexitarian (I include meat, fish, dairy and eggs in my diet but I make effort to reduce my intake of animal products)
- Vegetarian (I include dairy and eggs in my diet, but I do not eat meat or fish)
- Vegan (I do not include meat, fish, dairy and eggs in my diet)
- Religious diet (Halal, Kosher, etc...)

5. Do you have previous experience using breastmilk substitutes (commercial infant formula) as a parent?

- Yes, in combination with breastfeeding
- Yes, I have used BMS exclusively
- No experience

6. Do you have previous experience using plant-based breastmilk substitutes (commercial plant-based infant formula) as a parent?

- Yes, in combination with breastfeeding or cow's milk infant formula
- Yes, I have used plant-based BMS exclusively
- No experience

Section 2: Information on BMS market and consumption Patterns

7. Rate the importance you attribute to the following product attributes when choosing between different BMS (1= not important, 5= very important)

- Product Price
 Not important at all Of little importance Moderately Important Important Very Important
- Product Format (powder vs liquid, shelf-life, storage, quantity per package)
 Not important at all Of little importance Moderately Important Important Very Important
- Medical advice and recommendations
 Not important at all Of little importance Moderately Important Important Very Important
- Availability in Commercial Stores (Supermarkets, Pharmacies, etc.)
 Not important at all Of little importance Moderately Important Important Very Important
- Previous Experience with the product
 Not important at all Of little importance Moderately Important Important Very Important
- Specific nutritional attributes (anti-allergenic, easily digestible, higher in calories, hydrolysed, dairy-free, vegan...)
 Not important at all Of little importance Moderately Important Important Very Important

8. Rate the importance you attribute to the following quality marks when choosing between different BMS (1= not important, 5= very important)

- Organic
 Not important at all Of little importance Moderately Important Important Very Important
- Dairy Free
 Not important at all Of little importance Moderately Important Important Very Important
- Fortified with Nutrients
 Not important at all Of little importance Moderately Important Important Very Important
- Vegan
 Not important at all Of little importance Moderately Important Important Very Important

9. Between the following, what is your preferred base ingredient for BMS?

- Cow's milk
- Goat milk
- Soy
- Almond
- Rice
- Hydrolyzed milk protein
- Hydrolyzed plant protein
- Other....

10. Do you consider the following statements on plant-based diets in children to be true or false?

- Plant-based diets are not nutritionally complete and adequate
 True False I don't know
- Plant-based diets are not safe for children in age of development
 True False I don't know
- Plant-based diets are very hard to find and never available
 True False I don't know
- Plant-based diets may have a bad taste and be rejected by infants
 True False I don't know
- Plant-based diets in children are not recommended by doctors
 True False I don't know

11. What is your likelihood (as a parent) of choosing a plant-based BMS over dairy-based BMS (1= extremely unlikely, 5= very likely)

- 1= Very unlikely
- 2= Unlikely
- 3= Neutral
- 4= Likely
- 5= Very likely

Appendix 2: Consumer Survey (Italian - Original)

Sezione 1: Informazioni sul consumatore

1. Qual è il suo genere?

- Uomo
- Donna
- Preferisco non rispondere

2. Qual è il suo stato di genitorialità? *(possono essere applicate più risposte)*

- Non ho figli
- Sono in attesa di un figlio
- Ho figli di età non superiore ai 4 anni (include 4 anni di età)
- Ho figli di età superiore ai 4 anni

3. Quante fonti di reddito sono presenti nella sua famiglia?

- Mono-reddito
- Due redditi
- Altro: La mia famiglia ha più di due fonti di reddito o una situazione finanziaria diversa da quelle sopra indicate

4. Quale delle seguenti categorie descrive al meglio la sua dieta?

- Onnivoro (Nella mia dieta includo regolarmente carne, pesce, latticini e uova)
- Flexitariano (Includo nella mia dieta carne, pesce, latticini e uova, ma mi sforzo di ridurre l'assunzione di prodotti animali)
- Vegetariano (Nella mia dieta includo latticini e uova, ma non consumo né carne né pesce)
- Vegano (Non includo nella mia dieta carne, pesce, latticini e uova)
- Dieta di natura religiosa (Halal, Kosher, o altre)

5. Ha già avuto esperienze, come genitore, con l'uso di sostituti del latte materno (latte artificiale commerciale)?

- Sì, in combinazione con l'allattamento al seno
- Sì, ho usato sostituti del latte materno in modo esclusivo
- Nessuna esperienza

6. Ha già avuto esperienze, come genitore, nell'utilizzo di sostituti del latte materno a base vegetale (latte artificiale commerciale a base vegetale)?

- Sì, in combinazione con l'allattamento al seno o con il latte artificiale di latte vaccino
- Sì, ho utilizzato esclusivamente sostituti del latte materno a base vegetale
- Nessuna esperienza

Section 2: Informazioni sul mercato del latte in polvere e preferenze di consumo

7. Esprima l'importanza che attribuisce ai seguenti attributi del prodotto su una scala da 1 a 5 (1= not important, 5= very important)

- Prezzo del prodotto
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Formato del Prodotto
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Raccomandazioni del medico/pediatra
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Disponibilità del prodotto nei suoi supermercati/farmacie locali
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Esperienza con il prodotto
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Attributi nutrizionali specifici (anti-allergenico, digeribile, alto contenuto calorico, idrolizzato, senza componenti del latte, vegano...)
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante

8. Esprima l'importanza che attribuisce alle seguenti qualità del prodotto su una scala da 1 a 5 (1= not important, 5= very important)

- Biologico
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Senza componenti del latte
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Fortificato con nutrienti
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante
- Vegano
 Irrilevante Di Poca Importanza Moderatamente Importante Importante Molto Importante

9. Tra le seguenti opzioni, quale è l'ingrediente base di sua prima scelta nei sostituti del latte materno?

- Latte Vaccino
- Latte Ovino
- Soia
- Mandorla
- Riso
- Proteine del Latte Idrolizzate
- Proteine Vegetali Idrolizzate
- Altro

10. Do you consider the following statements on plant-based diets in children to be true or false?

- Le diete a base vegetale non sono nutrizionalmente complete e adeguate
 Vero Falso Non ne sono sicuro/a
- Le diete a base vegetale non sono sicure per i bambini durante l'età dello sviluppo
 Vero Falso Non ne sono sicuro/a
- È difficile trovare prodotti sostitutivi a base vegetale
 Vero Falso Non ne sono sicuro/a
- Gli alimenti a base vegetale hanno un cattivo sapore e vengono rifiutati dai bambini
 Vero Falso Non ne sono sicuro/a

- La comunità medica e scientifica non raccomanda le diete a base vegetale nei bambini.
 Vero Falso Non ne sono sicuro/a

11. Su una scala da 1 a 5, qual è la sua probabilità, come genitore, di scegliere un latte artificiale commerciale a base vegetale?

- 1= Molto improbabile
- 2= Improbabile
- 3= Neutrale
- 4= Probabile
- 5= Molto probabile