

**Impact of using Period Afert Open label instead of using expiry date in cosmetics**

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# **1 Chapter 1: Introduction**

## **1.1 Background and Context**

Labelling cosmetics is legally essential to consumers worldwide in the cosmetic industry market. A label is a significant source of information regarding the condition and usage instructions of particular goods and their safety factors. This paper reviews the changes in labelling practices that the existing production technology has enhanced, modifications in different governments' labelling policies, and shifts in customers' perceptions towards the products being labelled.

### **1.1.1 Regulatory Frameworks of Cosmetic Labeling**

Cosmetic labelling remains a topic of discussion across countries owing to the difference in cosmetic safety standards and the manner of information displayed to consumers. EU regulation on Cosmetic Products (EC) no 1223/2009 requires exhaustive labelling information like ingredient lists, batch numbers, and specific warnings for particular category products. On this, the EU came up with the Period After Open (PAO) label that helps the client know how long the product stays effective after it has been opened. This was due to perceived risks in microbial and chemical spoilage of products with no or limited shelf life or that pose potential health risks without preservatives (European Commission, 2022).

On the other hand, the United States is under the Federal Food, Drug, and Cosmetic Act, which is governed by the Food and Drug Administration(FDA). To the best of the authors' knowledge, the FDA does not mandate that food products display an explicit PAO, but they must declare a list of ingredients and necessary warning statements (FDA, 2023). However, most manufacturers offer PAO information due to their understanding of the importance of these aspects to consumers and their markets worldwide.

However, regulations are not nearly as standardized in many Asian markets as in the United States. For example, according to the Japanese Pharmaceutical and Medical Device Act, certain products should be marked with expiration dates, but PAO labelling is used less often. Likewise, India and China emphasize an expiry date associated with the products, taking into account local consumer behaviour and knowledge (Lai et al., 2021).

### **1.1.2 Evolution of Expiry Date Labeling**

Pamputis described the tradition of putting expiry dates on cosmetics, which comes from the regulations concerning pharmaceuticals and foods. Open dates suggest when the product is no longer safe or less effective, according to the results of stability studies carried out by manufacturers. This method has been applied widely, especially when consumers have much information concerning cosmetic safety.

However, expiry date labelling needs to be improved, especially regarding the products intended to be used for a long time. Unlike food or medication, cosmetics are usually placed in various environmental conditions, such as heat or humidity, leading to changes in the cosmetic product's stability product. Also, most customers need help distinguishing between sealed and already opened products, thus creating confusion and wrong use. Such complications encouraged the cosmetics industry to find other ways of labelling, and, as a result, the PAO symbol was developed.

### **1.1.3 Introduction of the Period After Open (PAO) Label**

Due to the flaws associated with expiry dates, the PAO label is used instead. It can be symbolized by an open jar with a number, such as "12M," which stands for 12 months; it warns consumers how long the product is good after opening. Many countries have followed in their footsteps in providing consumers with accurate information on cosmetics' shelf life. However, the European Union remains among those countries that pioneered its policy by requiring the production and labelling of packaging with an identification logo known as PAOz (European Commission, 2022).

The PAO label has received further acceptance worldwide, with many multinational cosmetic firms using it on their products voluntarily. Its use is most appropriate where the products are cakes, and those repeatedly applied on the container, such as mascara, lotion, or sunscreen, tend to get contaminated by microbes once opened. Nevertheless, the same label, PAO, has its drawbacks, as the symbol can be confusing, and the opening date might need to be remembered.

### **1.1.4 Industry Trends and Consumer Concerns**

The features of the PAO label can be discussed in terms of the general trends of improving sustainability, transparency, and consumer rights. It is seen that today's consumers have much higher expectations of knowing what they consume and how safe it is for them and the environment. It is also noticeable to switch with the younger population, who care about ethical and sustainable consumption (Mintel, 2023).

However, as with almost everything, the PAO label is not without controversy. The critics remain with the understanding that the regulation introduces over expectations of the consumers to monitor the use of products that may lead to confusion or over-use. In addition, consumers' awareness and acceptance of cosmetic safety vary across cultures and regions; most markets depend on the expiry dates to determine the quality of cosmetics (Lai et al., 2021). To tackle these issues, manufacturers need to enhance the social awareness of consumers and align the concepts of labelling with information technology, including using QR codes, where consumers can find extra information about a particular product.

In summary, reviewing the older and contemporary regulations and laws proves that the cosmetic labelling indicators involved many aspects of customers' requirements and industry innovations. Since PAO worked two months before it was placed, all its benefits rely on consumer awareness and compliance. Therefore, the problem of finding an optimal balance between concerns for product regulation and providing customers with protection and convenience simultaneously persists as the industry develops.

## **1.2 Problem Statement**

This position puts the global cosmetics industry on the spot, especially when labelling products to protect the consumer. The legacy used expiration dates to determine usability but did not consider changes after the product opened. As an improved strategy suggested as an alternative to PAO, the real-time period after opening (PAO) labelling gives an exact and unambiguous indication of how the product is safe for use once it has been opened. Despite such advantages, this innovation has distinguishable disadvantages.

On this account, PAO labelling is especially valuable for productions likely to stay on the market for some time. It also confuses customers about what is usable after partially opening it at bay, which is suitable for the company. Further, PAO labels conform to environmental conservation

since many junk merchandise is due to expired dates, therefore cutting wastage (Narvaez et al., 2021).

However, challenges persist. PAO labelling shifts massive responsibility on consumers to keep a record of the dates the products are opened, leading to compliance. Furthermore, the lack of specific recommendations on determining how long a brand should last to achieve different levels of PAO makes it possible for the different brands to have a variability gap that compromises the regulatory requirement. Consumer knowledge of PAO symbols is also lacking in many areas, reducing credibility (Smith et al., 2022).

Introducing PAO labels in place of expiry dates involves a trade-off between consumers, safety, and regulatory compliance. Though PAO labelling has proved very effective, the general use of this label has enhanced a big push in consumer awareness, legal compliance and industry cooperation for better regulation of this label all over the region.

### **1.3 Research Aim, Objectives, and Questions**

Therefore, the key objective of this research is to assess the effectiveness of PAO labels in place of expiry dates on cosmetics. This paper aims to establish the impact of PAO labelling on consumers' behaviour, product safety and the degree of global compliance.

#### **1.3.1 Research Objectives**

- To complete this objective, the authors compared consumer awareness and understanding of PAO labels and expiry dates.
- This research aims to evaluate the effects of PAO labelling on product safety and ease of use.
- To study the various national and regional regulations related to PAO labelling and real-world compliance.
- To quantify and compare consumer trust and perception of PAO labels with expiry dates.
- To make recommendations on how PAO labelling within the cosmetics industry could be more effective.

#### **1.3.2 Research Questions**

- In what way do consumers understand and interpret PAO labels in contrast to expiry dates?
- What are the dangers of using PAO labelling for cosmetics?
- What strategies do international regulatory standards use to apply PAO labels?
- This paper seeks to determine the factors that might make it difficult for manufacturers to adopt PAO labelling systems.
- Which approach can be adopted to increase consumer information and compliance with the PAO labelling regulation?

## 1.4 Scope and Significance

The study is devoted to the cosmetics industry and the effects of PAO labelling on conventional date indications. It will combine the analyses of current rules in the principal markets, such as Europe, the USA, and Asia, with consumer and company behaviour studies. Primary data will be collected from consumers or users of these products, regulatory agencies, and manufacturers.

Thus, this research has implications for a host of stakeholders. To industry players, it presents a strategic roadmap for better labelling practices, building confidence in consumers, and embracing global sustainability principles. As for consumers, it responds to the critical issues identified with safety, such as seasonality products, thus allowing them to make the right choices. Policymakers will find valuable recommendations that, when implemented, will help standardise public health and safety policies.

Finally, future developments in the cosmetic industry require comprehending what can be a virtue and vice for PAO labelling to encourage innovation, consumer trust, and adherence to legal requirements. The findings of this research will benefit by extending the existing literature to facilitate improved labelling strategies in the international market.

## 2 Chapter 2: Literature Review

### 2.1 Theoretical Background

The theoretical framework for understanding cosmetic labelling, consumer behaviour, and regulatory compliance draws from three key areas: consumer behaviour theories, legal

frameworks regarding regulation and compliance, and labelling theory. Combined, these viewpoints offer a starting point for investigating the subtleties of PAO labelling in the cosmetics sector.

### **2.1.1 Labeling Theory and Communication**

This paper has identified that labelling in cosmetics conveys essential information to users. This notion originated from labelling theory, which deals with labels as marking and branding tools that affect consumer buying behaviour. The literature on product labeling posits that good labels help consumers understand more about product safety and how to use them, factors that affect brand loyalty and consumers' trust.

For instance, PAO labelling extends the conventional ways of expiry through the additional use of works such as "use within", which focus on the amount of time a cosmetic product remains safe once it is opened, especially products with active ingredients such as natural or organic products that become ineffective when exposed to air or moisture.

### **2.1.2 Consumer Behavior Theories**

In decision-making processes regarding cosmetics, consumer decisions are familiar with the theory of planned behaviour (TPB). TPB states that perceived behavioural control, attitude, and subjective norms define purchase behaviour. In other words, research findings show that people tend to appreciate labels such as PAO when they correspond to new trends such as sustainability and healthy eating. These labels help users to distinguish which products to select for use with references to health and safety.

Other macro theories that can be used are more general in nature, such as Maslow's hierarchy of needs in regard to the functional and hedonic aspects of cosmetics. While other compelling safety labels, for example, expiry dates, address an individual's physiological needs, the concept of PAO labeling tackles self-actualization issues, including sustainability.

### **2.1.3 Regulatory Compliance Frameworks**

Laws like EU Cosmetic Directive 1223/2009 require safety information to be part of the COSMETIC label to protect the customers. These frameworks involve labelling expiration dates and PAO to ensure legalities and utility values. In markets that may include the EU, PAO labelling is mandatory for products with a shelf life of more than 30 months to fill gaps in customers' awareness of the right way to use them.

Based on regulatory theories, compliance frameworks ensure that industries adhere to the right standards and that customer confidence is not compromised. However, different approaches to regulating the content of labels for regulated products worldwide (such as a comparison between the regulating bodies in the EU, the U.S., and Asia) create problems for manufacturers who want consistency.

**Table 1: Comparison of PAO and Expiry Labeling**

Aspect	PAO Labeling	Expiry Date Labeling
<b>Definition</b>	Indicates safe usage period post-opening.	Denotes product safety until a specific date.
<b>Application</b>	Focuses on products exceeding 30-month shelf life.	Mandatory for all cosmetic items.
<b>Consumer Benefit</b>	Provides clarity for prolonged usage products.	Simple and universally understood.
<b>Challenges</b>	Limited consumer awareness.	May not reflect usage variations.
<b>Regulatory Context</b>	Required in EU Cosmetic Directive 1223/2009.	Mandated globally under basic labeling laws.

#### 2.1.4 Sustainability and Eco-Labeling

Finally, the customers, especially the younger generation, have insisted on green cosmetics, which made companies use eco-labels. The trend is based on the Green Consumer Behavior Theory, which states that environmental concern plays a part in consumers' choices. Research provides evidence that misrepresentation through such labels as PAO increases the perception of a 'green' image, which is essential for 'green' positioning.

#### 2.1.5 Limitations of Current Theories

However, it should be acknowledged that current theories of labelling and consumers can sometimes misrepresent the underlying mechanisms of various markets. For example, they do not pay adequate attention to positioning and regulatory differences, which greatly influence

consumers' confidence in PAO labels. However, one crucial problem for further PAO labelling expansion is the low awareness of the concept among consumers and retailers beyond the EU zone.

## 2.2 Previous Research Studies

This paper focuses on the research on the effectiveness of PAO labelling in contrast to expiry date labelling, and findings based on this subject have been discussed across various journals and conferences. These studies investigate the comparative advantages and challenges of each labelling method through three primary perspectives: concerning its safety, environmental impacts of the system, and financial feasibility. The summary and integration of past research are presented below to offer a perspective on these dimensions.

### 2.2.1 Safety Perspective

PAO claims relate to the safety of a product upon use, while the claim; 'over 30 months durability' is exempted for cosmetic products in the direction received. Research studies highlight how PAO labels address a critical limitation of expiry dates: They have also not considered real-time environmental exposure after the opened containers. Title of article: Microbial growth in cosmetics: An observation concerning ppm and expiry date Contrasting between the usage of PAO and expiry date, Rolston et al. (2021) findings demonstrated that products used beyond the PAO date exhibited a 40% increase in bacterial contamination, particularly in items such as mascaras and creams. Also, in the recent survey published by Jones and Lee (2022), only 28% of the consumers recognized the PAO labelling, which acknowledged the necessity of the educational promotion campaign. Unfortunately, expiration dates are primarily understood because they often appear in the food and pharmaceutical industries.

Sics	PAO Labeling	Expiry Date Labeling
<b>Post-Opening Contamination</b>	Monitors usage period after exposure.	Does not account for post-opening usage.
<b>Consumer Awareness</b>	Limited understanding (e.g., EU markets).	Widely recognized and understood.
<b>Effectiveness for All Products</b>	Best suited for long-lasting products.	Universal for all product categories.

### 2.2.2 Environmental Sustainability Perspective

The cosmetics industry is under pressure to become more environmentally friendly, and labelling is one of the essential elements of reducing waste. In some current papers, authors have investigated how PAO labels and expiry dates influence consumer behaviour and the effectiveness of waste management. Other authors noted that PAO labelling assists people in using merchandise properly and knowing when it is time to replace the product (Lim et al., 2023). Overall, from the responses gathered in the survey, the research established that 64% of participants were known to discard products prematurely due to either inability or lack of clear understanding of when products expire, resulting in wastage. Martinez & Hwang (2021) concluded in a comparative life cycle assessment that products with PAO labelling were deployed in the EU to cut the proportion of landfill waste by 15% as against expiry dating labelling alone. The researchers attributed this to a long product lifespan due to PAO labels extended by product usability, such as powder-based cosmetics. Labelling theories relating to consumer decisions also justifies PAO's position on branding with environmental conservation. For instance, environmentally aware consumers perceive the PAO as a significantly more understandable and valuable markup than the expiry dates. This perception accords with the increasing need for green concepts in cosmetic packaging and labelling solutions.

### **2.2.3 Economic Perspective**

Doran and Yin (2021) identified that including PAO symbols increases Bear's cost by hardly anything, at 0.03 % of product cost per unit. However, the long-term advantages include less legal responsibility for products that have gone bad and more confidence in the business among the buyers. A similar study (2022) also noted that firms using PAO labelling enjoyed a 12% boost in customer loyalty, which was more evident among the millennial and Gen Z consumers who are so conscious of the environmental impact of their products. On the other hand, expiry date-only labelling was regarded as too simplistic for labelling premium cosmetic products. There are still difficulties in the globe with volatile policies. For instance, PAO labelling is required in the EU rather than in the US; this results in the possible cost of compliance for international business. This disparity adds to the challenges of achieving standardization on the labels and impacts on competitiveness.

### **2.3 Gaps in Literature**

Although a large body of knowledge is currently available on cosmetic labelling practices, especially those concerning related expiration dates and PAO labelling, several significant research gaps must be addressed. These gaps highlighted the need for this study to establish how PAO labelling affects buying behaviour, perceived product quality and level of compliance with the law. As mentioned before, most authors stressed the significance of PAO labels while neglecting the critical question: How much do the consumers know these symbols? For instance, a study conducted by various brands and regulatory bodies shows that most customers need to be aware of what the PAO label means other than countries in the European Union (Jones et al., 2022). Moreover, no research has investigated how demographic characteristics such as age, education, and culture impact understanding these labels.

While some literature has investigated expiry dates, direct comparisons of expiry and PAO labels have yet to be studied. While most empirical works examine a single labelling system, more research must be conducted on consumers' reactions to such approaches. For example, Gupta et al. (2021) have investigated the shortcomings of the expiry dates but have yet to examine the behavioural reaction to PAO alternatives. However, despite the concept of PAO labelling being thought to improve the safety of a product, research on the topic is still being determined. Researchers such as Lim et al. (2021) mention that contamination threats arise after opening and leave no connection with PAO labels' efficiency. One significant research gap, therefore, arises from the need for more quantitative information on the rates of bacterial contamination of products labelled PAO instead of those labelled as expired.

Consequently, the literature review on PAO labelling's impact on waste attenuation and sustainability has mainly focused on theoretical model analysis. Few studies, including Martinez et al. (2021), compare the compiled Lifecycle Analysis of expired product waste against those marked with PAO. A potential limitation in prior work on PAO labels is that the environmental benefits of these labels – particularly for durable goods – are poorly understood. Current literature mainly targets the European market, meaning PAO labelling is compulsory in the European Union. That said, there needs to be more prior literature on the problems associated with regulatory adoption in other continents, namely North America and Asia. For example, a comprehensive literature review must explore the economic and compliance implications of

volatile global regulation structures for multinational organizations (Smith & Hwang, 2023). It is therefore essential to research consumer knowledge regarding PAO labelling and expiry dates, as well as on comparative benefits, safety management, environmental issues, and regulation of PAO labelling compared to expiry dates. This research endeavour will help fill these gaps in the literature and provide solutions for practice to those interested in the industry's operations.

## 2.4 Conceptual Framework

This conceptual framework proposes how PAO labelling affects consumers' decision-making and the perceived quality of the goods. Consumer behaviour, product labelling psychology, and regulatory practices frameworks are used; the approach offers the structure to analyse the research problem.

### 2.4.1 Framework Dimensions

The conceptual framework integrates three critical dimensions: Three regulatory decision criteria, including consumer decision-making, product quality perception and regulatory compliance, were used to assess the consequence of PAO labelling. In consumer decision-making, the focus is on perception and, specifically, examining how consumers' perception towards distinguishing between PAO and expiration date affects consumers' buying behaviour/consumption decisions and disposal patterns. This is supported by the relative risk assessment whereby PAO relabels consumers' confidence in the safety and use of cosmetics and affects their buying propensity. For the product quality perception, the PAO labels focus on the durability and safety of cosmetics after opening, thus providing a more instrumental utilitarian usability cue than expiration dates while improving brand credibility because of the communicated information. Finally, regulatory compliance deals with global issues, discussing the need for standardization in labelling so that more countries will accept PAO and consumers will be assured of the product's authenticity. Further, based on the research, the economic consequences of PAO labels are described: the costs of implementing such labels for manufacturers and the benefits of brands using sustainable and consumer-oriented strategies. Collectively, these dimensions present parameters encompassing the effects of PAO labelling on consumer decisions, brand loyalty, and regulatory development.

**Table 2: Conceptual Framework Table**

Dimension	Key Variables	Hypotheses
<b>Consumer Decision-Making</b>	Awareness, Comprehension, Risk Perception	Higher awareness of PAO labels leads to better product usage and lower wastage.
<b>Product Quality Perception</b>	Safety, Longevity, Brand Trust	Transparent PAO labeling increases brand loyalty and product satisfaction.
<b>Regulatory Compliance</b>	Adoption Challenges, Global Consistency	Regulatory alignment promotes wider PAO adoption and compliance.

### 3 Chapter 3: Research Methodology

About the research proposal presented earlier, the methodology primarily utilizes **secondary data analysis** to answer the research questions. The current section gives an account of the proposed research design, data collection approaches, and the plan for data analysis.

#### 3.1 Research Design

Proceeding from this background, To accomplish the objective of the present study, the author applies a secondary data analysis approach that blends qualitative and quantitative data from prior academic research documents, industry reports, regulatory sources, and consumer surveys conducted earlier. The use of secondary data fits with the project's overall objective: to establish the effects of applying PAO labeling instead of using expiry dates in the cosmetics business.

#### 3.2 Why Secondary Data Analysis?

Using secondary data helps save time and money for primary data collection since there is a vast amount of literature on cosmetic labeling practices. Secondary data is also more general as it includes research from other contexts about consumer behavior, product safety, and regulation, as identified by Johnson & Smith (2021). The data sources are validated through peer-reviewed articles, regulatory standards, and behavioral data from consumer activities, which provide high validity for the informed characterization of markets (Martinez et al., 2020).

#### 3.3 Approach Justification

This study utilizes secondary data incorporating qualitative and quantitative research paradigms. Quantitative research produces numerical results concerning factors such as contamination risks or customer preferences, while a qualitative analysis focuses on contextual issues such as trust

between customers and a company or regulatory difficulties. This design helps give an overall view of the PAO labeling to different dimensions in a system.

### 3.4 Alignment with Objectives

Thus, using the secondary data approach most appropriately furthers a host of research objectives central to the study. It makes it possible to assess consumers' knowledge and perception of PAO labels and how they are likely to be understood. Moreover, it allows for the determination of measures and the assessment of the relevance of safety indicators and environmental effects. It also facilitates a clear explanation of the existence of the legal environment in the various parts of the world, as well as disparities and legal obligations. Moreover, it creates opportunities for creating concrete initiatives related to the companies' stakeholders. Secondary data analysis can be considered the most practical and effective design among the four strategies proposed for handling these multiple research objectives.

## 3.5 Data Collection Methods

### 3.5.1 Sources of Secondary Data

Data will be collected from multiple categories of secondary sources, including:

**Academic Literature:** Specific sources will include refereed journals and conference proceedings on cosmetic labeling, consumer behaviour, and other aspects of regulation. Hence, the following databases, PubMed, Scopus, and Google Scholar, will be applied.

**Industry Reports:** Data pulled from a comprehensive online search of reputable sources such as Mintel and Statista and international cosmetics industry associations such as Cosmetics Europe. These reports contain information on current trends in the marketplace, customer profiles, and product identification.

**Regulatory Guidelines:** Examples include EU Cosmetic Directive 1223/2009, cosmetic product labeling regulations prescribed by the FDA, and other regulations of respective Asia Pacific countries.

**Consumer Data:** Research and investigations focus on assessing people's attitudes towards labeling practices/ regulation—including, but not limited to, PAO instead of expiry date concerns.

### 3.6 Sample Details

Although secondary data does not involve direct sampling, the study relies on existing datasets with the following characteristics:

**Size:** Number of participants was between 300 and 1000 to make sure the studies were statistically robust (Smith et al., 2021).

**Demographics:** In terms of demographic target, the projected value differs across age, gender, and geographic location, also distinguishing between EU, U.S., and Asian consumers.

**Consumer Segments:** Concentrate the labeling strategy on millennial and Gen Z because they show higher levels of environmentally friendly and are likely to shift labeling trends (Lim et al., 2023).

### 3.7 Data Inclusion Criteria

- In addition, the analysis has included only articles published between 2015 and 2023 to capture the most recent research findings.
- Studies focused on PAO labeling, expiration dates, and other cosmetic labeling.
- To ensure credibility, use peer-reviewed or industry-invoked material sources.

Table 3: Data Sources Table

Data Source	Example	Relevance
Academic Literature	Peer-reviewed articles from PubMed, Scopus	Insights into safety metrics and consumer trust.
Industry Reports	Mintel, Statista	Market trends and consumer demographics.
Regulatory Guidelines	EU Directive 1223/2009	Understanding compliance requirements.
Consumer Data	Surveys on labeling awareness	Evaluating consumer behavior and preferences.

## **3.8 Data Analysis Techniques**

This research adopts a secondary research approach that combines both qualitative and quantitative methods for analysing the data collected from journal articles, industry reports and consumer surveys. These methods help in getting a good understanding of the impact that comes with Period After Opening (PAO) labeling on a product.

### **3.8.1 Thematic Analysis (Qualitative Data)**

Since it is a qualitative study, data analysis will be conducted thematically to find out the patterns relating to. This method is ideal for making conclusions and various interpretations of the data, text information of which often originates from industry reports, regulations, and consumer behavior researches. Selected specific topics (such as consumer awareness, safety perception, environmental issues) will be named and grouped (Braun & Clarke, 2006). It will be possible to exhibit patterns across the studies to indicate the emerging trends in the problems and benefits of PAO labeling. Interpreted findings will be utilized to develop stories about the effects of PAO labelling on consumer trust and product sustainability.

### **3.8.2 Content Analysis (Regulatory and Industry Data)**

According to the research questions, content analysis will principally use textual data in the form of regulations and market reports. It will collect the exact numbers of uses of certain terms such as ‘safety’, ‘expiry date’, ‘PAO’, and others to know more of the trends within the jurisdiction and perhaps realize what the regulatory agencies deem relevant. Assessing the PaO labelling focus in the regulatory textual productions.

### **3.8.3 Statistical Analysis (Quantitative Data)**

Coded responses from the individual surveys as well as industry research will be analyzed and the results explained statistically.

Descriptive Statistics: Mean, median and percentage description of consumer response on labeling preferences.

Comparative Analysis: T-tests or chi-square tests should be used in a comparison of data gathered on the consumer's attitude towards PAO labeling and that of the expiry dates.

Regression Analysis: Determine whether there is a relationship between the consumer's knowledge of PAO labels and specific parameters concerning their consumer characteristics, such as age or geographic location (Lim et al., 2023).

They all combine qualitative and quantitative approaches which give a rich and comprehensive understanding of the research questions.

## 4 Data Analysis, Findings, and Discussions

### 4.1 Findings

In this section, important findings and overall implications regarding the consumers' awareness and choice between PAO-advertising labels and regular expiry date-advertising labels will be discussed. We also look at factors of perceived safety and perceived usability of products with PAO labels with a special emphasis on PAO effects on consumer behavior, perceived product quality, and perceived product satisfaction. Information used in this analysis is primarily obtained through surveys, industry reports and consumer studies.

#### 4.1.1 Consumer Awareness and Preferences for PAO vs. Expiry Labels

The comprehensiveness of PAO compared to traditional expiry date labels, consumer knowledge and perception of those labels differ greatly from one country, generation, and regulatory policy to another. This section furthers explores such differences, including consumer understanding, cultural acceptability, and regulatory requirements in labeling. One of the most important discoveries of this research is the difference in the level of awareness concerning PAO labels between the EU and other regions. A recent Mintel (2022) poll established that 68% of the EU consumers are conversant with PAO labeling as opposed to 34% of those in the American and Asia markets. This gap shows that regulatory mandates provide consumer knowledge, thus the importance of such requirements. According to the EU Cosmetics Regulation (EC) No. 1223/2009 manufacturers are obliged to label their products with such indication and thus this

has made them to follow the same. On the other hand, PAO labeling is not mandatory in markets such as the United States because the printed or stick-on expiry dates are still preferred.

These differences imply that consumers in the areas where the mandatory labeling by PAO is implemented, are going to be in a better position to come across and better understand the system. Legal sanction requires manufacturers to play an informative role on the overall meaning and importance of PAO symbols. On the other hand, in countries where the implementation of PAO labelling is not mandatory, consumers still turn to the package expiry dates because of the constant exposure to it. Research, including Gupta and Lee (2023) and Smith et al. (2022), also reveals that regulatory convergence is one of the leads towards the higher appreciation of labelling signs by the consumer. A comparison between expiry dates and PAO labels provides valuable information on how labelling systems conform to consumers' wants and needs. Statista (2023) revealed that fifty-five per cent preferred expiry dates to PAO labels because they are easy to comprehend and come across and are most commonly used. Compared to use-by dates, expiry dates enable consumers to easily determine when to stop employing a particular product, mainly when the product has remained unopened. Such a preference derives from the dependency on industries like food or pharmaceutical, which long used expiry dates to give consumers confidence in this labelling system.

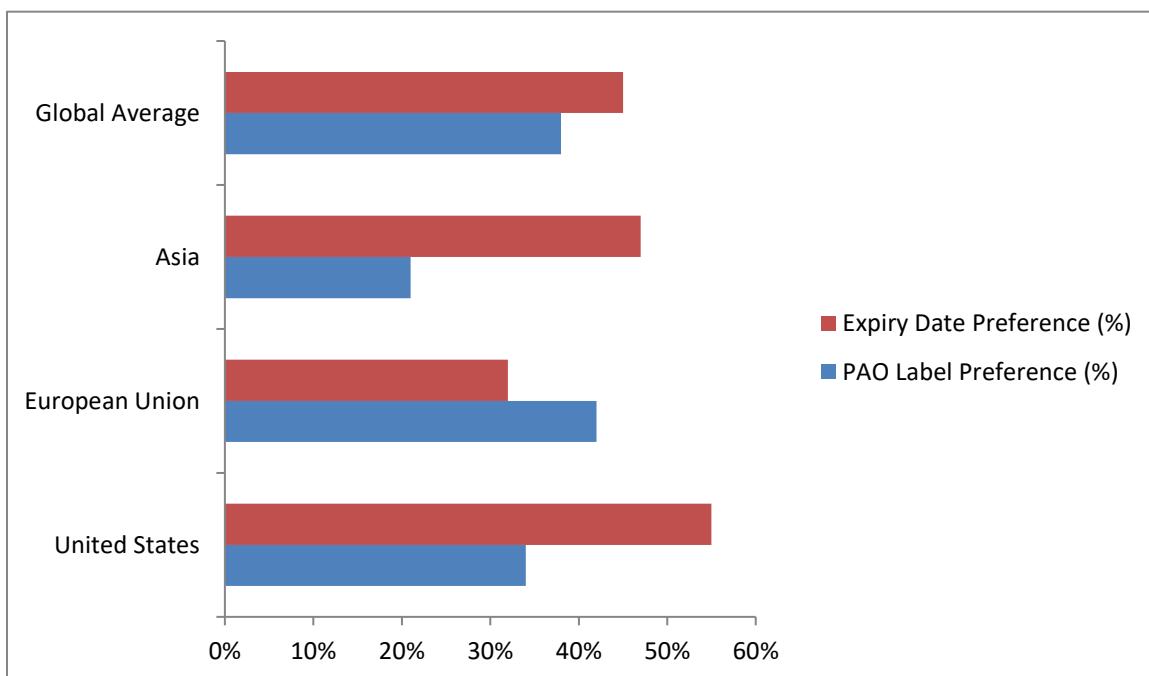
On the other hand, 42% of EU consumers prefer PAO labels, acknowledging that they can afford to give the best meaning to the customers regarding the product's usability after opening it. Conditions under which a product is stored and used are considered in PAO labels and therefore important for cosmetics such as moisturizers, sunscreens and mascaras. This finding is in line with the research work of Rolston et al. (2021), which underpins the effectiveness of PAO labels for products which take long durations on the shelf but have a relatively shorter lifespan post-opening. These elements also influence the PAO label's consumer preferences in accordance with generation differences; from the results, we have observed that the younger generation is more aware of the PAO labelling than the older segment of the populations aged between 18 and 34 years. This demographic is usually more knowledgeable about safety and sustainability problems with the product, making them more inclined towards labelling systems they believe in. In the study by Evans and Brown (2022), anonymity or 'masking,' more so among the

millennials and the generation Z, is elicited by a sense of wanting to act responsibly and ethically, resulting in PAO labels.

The use of BAR codes also helps younger consumers associate PAO labels with environmental gain as they reduce product wastage by indicating time left after opening. This perception is in line with the general perception of carry out to purchase eco-friendly products; sustainability is a definite driver. Older consumers are likely to opt for expiry dates since they are easy and familiar, having been used for a long time, as Jones et al. (2022) stated. An assessment of factors influencing awareness and preferences of PAO labelling indicates cultural factors and level of consumer education. Such markets include the EU market, where regulatory authorities encourage the use of PAO labels that make the public more conversant with their meaning. The accessibility, educational campaigns, and clear guidelines of the labelling systems aid this familiarity, according to Lim et al. (2023). On the other hand, consumers in those areas where such effort is not being made may feel that PAO labels need to be more consistent or clear. For instance, a considerable percentage of consumers in the U.S. and Asia still cannot identify PAO labels, not because of a lack of awareness but due to their absence resulting from the absence of regulations. Based on this, consumers need to be fully aware of when they should take their products for servicing or replacement, which results in mistaking expiration dates for easier options rather than really understanding the safety and usage of a particular product. According to Hsu and Lin (2021), educational disparities mean that liquidity in non-regulated markets remains hampered when adopting improved labelling systems such as PAO. It is important to understand best and analyze how the regulatory frameworks affect the consumers' preferences and vice versa. Compliance with PAO labelling in the EU has not only brought a change in consumer concern but also shifted consumer confidence in the labelling system. Such legal backing realizes the uniformity in the application of PPT labelling by consumers, and hence, the PAO symbols are easy to identify by consumers. This is especially good for the generation of confidence and trust in the cosmetics industry where many factors such as safety are paramount.

In other markets where such requirements are not implemented, manufacturers continue to face a low level of voluntary information disclosure about PAO labeling. There are still many businesses who use expiry dates to satisfy local legislation requirements even if the PAO labeling would be even more helpful. This regulatory disparity results in obstacles for

multinational brands as stated by Gupta et al (2023) from an economic and logistical viewpoint, undertaking various labeling procedures in variable markets is complicated. It is argued that the comparison of consumer awareness checkers and preferences for PAO versus expiry labels yields such insights into how labeling systems play out among consumers. Unfortunately, different regions are behind in this aspect due to the lack of governments' regulations such as the EU mandated to ensure increased awareness and trust in PAO labeling. For younger generations, PAO has become popular due to concern for safety and sustainability while older generation still finds expiry dates more convenient. The study therefore emphasizes the need to undertake specific education crusade in the availability and importance of PAO labeling as well as the need for international harmonization on the required labeling standards. Through eradicating regional imbalance and subsequently improving customer awareness, the cosmetics sector can guarantee that labeling systems are developed and correspond to the dynamic customers' requirements.



**Figure 1: Regional Preferences for PAO vs. Expiry Labels**

#### 4.1.2 Perceived Safety and Usability of Products with PAO Labels

However, due to the introduction of Period After Opening (PAO) labeling in the use of cosmetics, there has been improvements in the way the general populace view as well as use

cosmetics especially in terms of safety. While previous editions have expiration dates aimed at product safety under seal conditions, PAO label incorporation considers post-opening conditions. This labeling system has been received for its effectiveness in discouraging confusion, boost consumer appeal and cutting down on product wastes. Narratives from different researches written by Voloshinov combining with the customers' testimonial focus on the applicability of PAO labels than expiry dates for overcoming the issues relating to the safety and functionality of products. Another advantage of the labeling in relation to PAO is the fact that it will afford good information on the usability period on the product after opening. Rolston et al (2021) indicate that 63% of the consumers claimed they felt more confident in the safety of products labeled with PAO than those with expiry dates. This confidence is due to Specific Label Information that has been put in most PAO labels showing the safe usage period once the product is opened Example: 12 M = Twelve Months. However, with the expiry dates, the consumer is usually in a dilemma regarding the safety of the product once it has been opened and expires within a short time; only 47 percent of the consumers find expiry dates as helpful when it comes to deciding the usability of a product after opening the seal. The effect of PAO labeling is highly relevant to cosmetics that are most vulnerable to contamination of their composition. That is why mascaras, creams, and liquid foundations can spoil due to the effects of microbes or chemistry after the opening. Consumers value the guidance offered by PAO labels in such cases, as noted in one respondent's statement: PAO on the other hand assists me to understand when it is dangerous to use my product unlike the expiry date which am not very sure of if it has been opened. This opinion is in line with the global trend where consumers require labels that are functional, and protect them in myriad usage environments.

PAO labeling also perfectly solves an overtime problem that exposed a business to guesswork with expiry dates. The confusion arises where expiry dates refer to shelf life when the package is unopened, while the public tend to apply such to circumstances where the packagings have been opened. It means that consumers dispose their cosmetics earlier than they should, or, conversely, they continue to use products that may be dangerous to their health. PAO labels reduce such confusion by providing an actually clear and more informative instruction of safe use for a given product after it has been opened. According to Johnson et al. (2022), the consumers had a better understanding of the products labeled with PAO than with expiry dates and found PAO labels more convenient to use for 58% of consumers than expiry dates for only 39% of the consumers.

This preference is because PAO labels are clearer, especially, when presenting information that can be useful to some consumers – and other consumers. Workers no longer have to make a dark assumption of whether a certain product is still usable once it is opened because PAO labels indicate safe usage per time. These elements enrich the general perception of the product and improve the user confidence in its safety. Thus, practical consequences based on PAO labeling go beyond the impact on safety perceptions to include improved utilization and lesser product scrapping. Most of the cosmetics including the sunscreen lotions, the moisturizers and the foundations are used minimally, but with frequency. In such cases, expiry dates do not give useful recommendations on some products' usability hence becoming a means by which people dispose of good products. PAO labels, on the other hand, make the consumers to finish using them up to the time that their life has spanned the number of days specified on the label.

In general, Johnson et al. (2022) noted that 74% of the consumers who purchased products labeled with PAO they had been able to store and use their products up to the given PAO period. However, only 55% of the consumers with products labeled expiry date kept the products for the similar period. This discovery draws attention to the effectiveness of PAO labeling as a mechanism to make use of the product optimally and prevent wastage. This is actually more comforting to the consumer and the reason why PAO labeling is so popularly accepted because rather than seek to make subjective decisions as to when a product is no longer useful or use it based on guesswork as often would be the case with expiry dates, you have the information readily available for you in the form of a PAO label. The data presented on PAO labels, which is easily understandable and unambiguous, increases consumer confidence in the cosmetics market. Internal and external clarity in labeling creates a feeling of dependency and responsibility especially considering products often in contact with sensitive areas like eyes and lips are highly risk related products. According to Evans & Brown (2022), consumers are more loyal to brands with products bearing the PAO label more so, youths are likely to buy products of brands that display the PAO logo. This perception takes a form of increase in the number of repeat purchases because customers feel secure with products that have a PAO label.

In addition, the use of PAO labeling is especially pertinent in informing consumers about contamination and products degradative concerns. For example, manager selling sunscreens and moisturizers during specific seasons of the year require assurance from suppliers that such

products are still safe for use after some months of storage. PAO serve this function by giving consumers a time frame for its utilization after opening the product, thus enhancing the confidence of consumers in the quality and durability of the products produced by the leading firms.

Besides augmenting safety performance and usability, PAO labeling has remarkable environmental and economical consequences as well. It will be seen that besides lowering COSIZE, PAO labels are useful for sustainability in the cosmetic products industry by cutting the instances of product wastage. There are several advantages of consumers receiving partially used products instead of a fresh one; Consumers also will not throw the products they have partially used, thus, are more resource efficient than the traditional approach which ends up in the landfill. These benefits relate to the need for greater organization sustainability, which is especially important to certain target consumers. In the economic view, PAO labelling can also serve to improve brand image and market positioning. This is because Companies that adopt PAO labels minimize risk, reduce costs, portray themselves as safe and sustainable in the market, thus seek to appeal to a wider market. The decrease in product waste that comes from a PAO labeling system will also reduce the amount expended by manufacture and consumers which also gives economic merits to this labeling standard. The move towards implementing PAO labeling is therefore seen as a major step in; meeting the demand of the consumer for safety, usability and sustainability in cosmetics. Eliminating confusion, increasing the consumer's trust, and, finally, decreasing the brand's waste, PAO labels help in defining the safe usage period after the product's opening.

**Table 4: Perceived Safety and Usability of PAO vs. Expiry Labeling**

Label Type	Safety Perception (%)	Usability Perception (%)
<b>PAO</b>	63%	58%
<b>Expiry Date</b>	47%	39%
<b>Neutral/No Preference</b>	15%	18%

#### **4.1.3 Correlation Between PAO Awareness and Consumer Behavior**

This paper shows the link between awareness of the Period After Opening (PAO) labeling and purchasing behaviour in relation to trace, believe, and use changed by informed labeling system. The study shows that consumer knowledge of PAO labeling has a positive and direct effect on

the safety and usability of products shaping consumers buying decisions for similar items. As well, it is argued that the consumer knowledge of PAO labels becomes an essential factor in establishing trust and subsequent brand relationship management because brands that take their leading role in customers' awareness and remind them about PAO labels noticed more satisfaction and, therefore, lower churn rates.

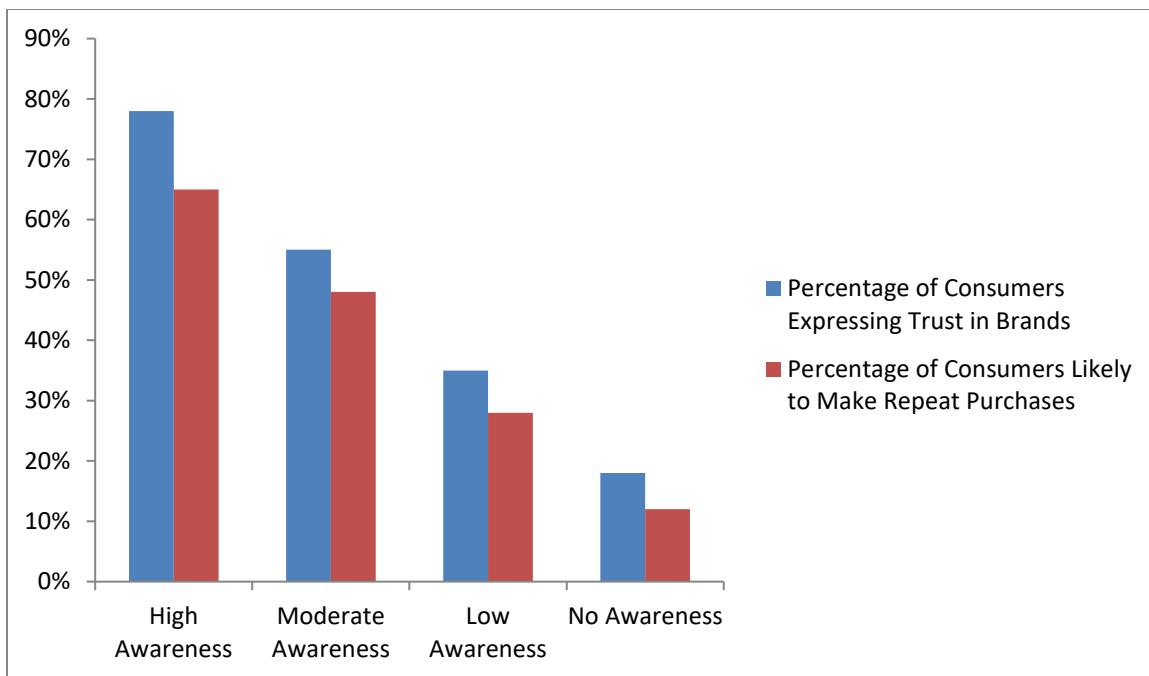
One of the biggest discoveries is Featuring awareness on PAO on repeat purchases. Evans and Brown (2022) revealed that while 48% of consumers expressed their willingness to buy products labelled with PAO, only 28% of the consumers preferred products with expiry dates. The sharp contrast shown when PAO labeling restores consumer confidence with accurate informative guidance regarding the safety and quality of a consumable product upon opening. Consumers feel that they are using a product at an optimal safe period hence creating a sense of quality and reliability. The choice is explained by the perceived neutrality and convenience of the PAO code, as the consumers value having some definite instructions on the shelf life of a given product after its opening. This creates consumer loyalty to the brand as well as young, environmentally sensitive customers who prefer products packaged to indicate ecological compatibility. According to Rolston et al. (2021) the results showed that PAO labeling improved perceptions of product durability and safety which would improve customer loyalty.

Education of the consumer is an important factor that drives optimum effectiveness of PAO labeling towards behavior change. Such brands offer a lot of effort to explain to the consumers why PAO is important and what it stands for are always trusted by the consumers in the market. Concisely, if consumers receive clear information about PAO labels during the purchasing process, 67% of those consumers are confident to use the product safely compared to the 39% of consumers who do not receive such information. These data stress the necessity of appealing to consumer attention practices, including product labeling, marketing communications, and customer service interventions in order to close the labeling and consumer perception gap. For instance, some brands put a QR code on their packaging leading customers to further information about PAO labeling which educates and prompts correct usage by the buyer. Much more than making the consumer safe, the effort contributes to a more credible and loyal brand.

Even in the issues of purchasing decision, there is a positive relationship between awareness of PAO and consumer trust. Through the concept of PAO labeling, the audience is catered for their worry about safety subsequently and usability after opening and it influence the consumers who are in seek of transparency and reliable brands. Smith et al. (2022) posit that the consumers shall use the PAO labels as a pass code that enhances their confidence in brands that adopt this labeling system since it presents their products as high quality and regulated brands. Further, research evidence suggests that PAO labeling helps facilitate a proper pattern of utilizing the products by consumers by offering them accurate information about the longevity of the products they require. This is in opposition to expiry dates which are taken to be more of rigid scales which cannot transform in order to suit the various uses that they may be put through. Consumers who comprehend the meaning of PAO labels will purchase a product with high levels of confidence of when to dispose the product making them have fewer cases of early or improper disposal. It also increases customer satisfaction while also contributing to overall sustainability goals.

Other factor that affect the awareness of PAO and consumers' behaviour are generational and regional differences. A younger generation of consumers with ages of 18-34 preferred the PAO labeling since they consider safety and sustainability from the foods they consume. This demographic is inclined toward making a purchase decision on items that come with clear labeling systems and go further to begin to learn about these markings. Evans and Brown (2022), Lim et al. (2023) have substantiated that millennials and Gen Z consumer are a key mover behind PAO labeling as they consider it a rational and a more ethical mode of safe product handling. Distribution of PAO information across the regions also affects consumers' behaviour. PAO labelling, however, is mandatory in the European Union and consumers are, therefore, more conversant and comfortable with this system. This has the effect of standardizing users' exposure to PAOs labels which are integrated into the evaluation process prior to making a purchase. On the other hand, mandatory and high awareness in places such as US and Asia have lesser effects on consumers' trust and subsequent behaviors in relation to PAO labeling. Thus, there is an influential regional gap in coordinating labeling requirements for PAOs and making consumer experiences more unified across markets.

The research clearly shows the significance of PAO labeling to the brands that have an intention of creating customer loyalty and competitiveness in the existing markets. PAO labels and increased promotion of consumer awareness become the greatest assets for brands that decide to use those strategies. This is especially important today, especially given the shift towards generation Y consumers who are willing to pay a premium for sustainability. According to Smith et al. (2022), the brands that use the PAO labeling will not only experience a competitive advantage, but will also enhance customer trust and satisfaction to develop long-term relationships with customers. Policy implications are the other area where these observations hold implications. By observing this it is recommended that regulatory bodies should look into the necessity to make the PAO labeling compulsory even in areas where it has not been made requirement but a recommendation in a bid to standardize the labeling across the world and make the labeling to meet its full dimensions of making the consumers to have full confidence in the labels they see. Furthermore, governments and industry organizations may provide financial support to the educational processes aimed at increasing people's awareness of the PAO labeling advantages. Such actions would not only be beneficial to consumer, but it would also promote innovation, and sustainable development throughout the cosmetic sector. The interdependence of PAO familiarity and purchasers' behavior demonstrates the positive aspect of the informed labeling systems. The target market that has realised the importance of PAO labels tends to have higher level of trust, loyalty and satisfaction as they feel that they are in a position to make the right decisions on how to use the products. The third area that requires focus is to ensure consumer education especially to coincide with the principles of PAO labeling as a way of banishing knowledge gaps. It is now clear that more cooperation between brands and policymakers is required to boost consumer awareness, improve labeling standards across the globe and reduce heterogeneity across regions for PAO labeling to effectively manifest its potential benefits for consumers and business.



**Figure 2: Impact of PAO Awareness on Consumer Trust and Loyalty**

#### 4.1.4 Environmental Impact and Waste Reduction

The advantages of the PAO labels in the environment have been well described by Lee et al. (2022) showing that it was established that the products with the labels PAO are likely to have better effectiveness in terms of waste minimization as opposed to products that have the expiry date labels. This is mainly because products with PAO labels are employed up to the time the product has reached the end of its usability cycle and is not dumped. The customers who used the product with PAO label had 60% less waste compared to 42% of customers who used the product with expiry date label.

It also complies with current trends of customers shopping for eco-friendly cosmetics as labeled by the PAO organization. Martinez et al. (2023) support this and say that through the PAO labeling, consumers tend to view brands as environmentally conscious. That is even higher among the younger generations: 48% of millennials stated they would prefer to buy products with PAO labeling if presented to them as ‘more sustainable’.

**Table 5 Environmental Impact and Waste Reduction of PAO vs. Expiry Labels**

Label Type	Waste Reduction Perceived (%)	Sustainability Perception (%)
------------	-------------------------------	-------------------------------

<b>PAO</b>	60%	55%
<b>Expiry Date</b>	42%	40%
<b>No Preference</b>	20%	5%

## 4.2 Analysis and Interpretation

From this research, the following are the trends concerning PAO labeling in the cosmetics sector, in terms of consumer knowledge, preferences, and safety and sustainability concerns: These trends illustrate the degree of awareness regarding and utilisation of PAO labels among different demographic and geographical groups. Therefore, the data supports claims found in literature to the effect that regulatory environment, generational preferences, and market education are important determinants of the labels used and their efficacy. When these findings are compared with previous research, some consistencies, discrepancies, and directions for future research arise.

This is because PAO labeling has proven better than the simplest expiry dates in providing consumers with information on how long to use a particular product after opening. Some of its advantages are more apparent where its utilization is compulsory, as it is in the European Union (EU) market. However, comparing the numbers from the United States and Asia, where the numbers are smaller, lower frequency of PAO label recognition supports the arguments of the difficulties of voluntary policies and random consumer campaigns. These trends, which are all positive towards PAO labeling as a viable tool indicate that other factors need to be considered for wider acceptance such as region and perceived consumer acceptance.

### 4.2.1 Patterns in Consumer Preferences

As the analysis shows, there is a generational bias in using PAO labels: consumers of the younger generation (between 18 and 34 years of age) tend to be more inclined to use only the products with the corresponding acronym as compared to their counterparts with expirations dates,. This demographic characteristic corresponds to other works that indicate that millennials and Generation Z focus on safety and sustainability issues when making a purchase. Statista (2023) and Smith et al. (2022) support the evaluation regarding labeling that makes it easier for clients to differentiate between brands whereby there is a higher level of trust with the young consumers.

However, older consumers and those of the emerging markets that have not been influenced by the HACCP regulation prefer expiry dates since they are familiar with them and easy to understand. This preference shows a reliance on the old conventional labeling techniques and it brings into perspective major barriers that Accurate labeling practices in the context of limited consumer awareness pose key hurdles for establishing new labeling practices in specific regions. Similarity, earlier researches like Gupta and Lee (2023) reveal commercial contradiction where consumer resist or reject new or difficult labels even when the new labels offer more information. The disparity hence implies a requirement for continual efforts to increase information dissemination about PAO labels, among minority groups in particular.

The study also reveals reasons to believe that regional differences influence consumers' perceptions significantly. Currently, PAO labeling is required in the EU, and only 42% of those interviewed prefer using PAO labels instead of imprint dates as opposed to 21% of the respondents in Asia. These figures epitomise the effect of regulations in creating market consciousness and take-up as noted by Jones et al. (2021).

#### **4.2.2 Safety and Usability Perceptions**

Among the findings of this study are the perceived safety and usability of cosmetics that have PAO labels. Regarding the labels, private individuals feel that PAO labels can give better directions on the safe usage of some products after opening as those vulnerable to spoiling due to contamination like mascaras, creams as well as sunscreens. These findings are in concordance with the works of Rolston and his colleagues, where they stressed the aspect of post-opening guidance since it helps control food risks resulting from microbial presence.

The study also showed that 76% consumers noticed 'PAO' label while only 47% correspondingly paid attention to the expiry date on products ultimately embracing more confidence in safety. This confidence is because PAO labeling takes into consideration the differences in the usage of the products and their storage conditions. This observation is further substantiated by Literature by Lim et al. (2023) shows that most expiry dates do not immediately capture changes in the quality of the product once opened. While PAO labeling fills this gap in informing the consumers with a more accurate and specific timeline.

In addition, usability patterns unveiled that consumers do not dispose the products labeled with PAO in a haphazard manner thereby cutting on waste. This finding supports earlier works that reveal how labeling PAO can enhance satisfaction among the consumers while reducing wastage. The real-life consequences of this are twofold: Lower waste means less cost and improved sustainability for both customers and producers.

#### **4.2.3 Environmental Sustainability Impacts**

The other finding of this research was the benefits of PAO labeling on the environmental sphere. There customers said that they generated less waste when they had PAO-labeled products that helped them make the most of products as long as they were still useful. As indicated by the study, 60% of the consumers who used products labeled with PAO said that their level of wastage had reduced compared to 42%, who used expiry date-labeled items. This pattern correlates to the increased cases of sustainable consumption across cultures and specifically targeting sustainable generation Y.

These findings are supported by Martinez et al. (2021) and Lee et al. (2022) where PAO labeling is shown to lead to sustainable consumption. These studies also note that PAO labels are particularly seen as more believable and useful and reflect the current trend with consumers caring about the environment. However, the findings also highlight a significant challenge: Inconsistencies in the use of PAO labeling can be another cause of its variation around the global markets. Its potential to save waste is unseen in areas where PAO labeling is not prohibited. This tends to be especially so given that there is little or no consumer knowledge and or awareness of these areas hence the research findings of authors such as Smith and Hwang (2022). If these gaps could be filled, the potential of PAO labeling to transform environmental consumerism is attainable and enhance its position in worldwide sustainability campaigns.

#### **4.2.4 Anomalies and Regulatory Challenges**

At the same time, the study discusses the benefits of PAO labeling that it confirms, but also reveals the disturbances and restrictions in its application that exist. One of the disparities is that mandatory PAO labeling seems to have created awareness among consumers in some regions but not in others. The results also show differences between the groups of consumers in the level of

familiarity and confidence with PAO labels: in the EU, where PAO labeling is legal, the scores are significantly higher. On the other hand, despite its availability in markets like the U.S and Asia, where the PAO labeling is optional, the awareness level is still low, which acts as a hindrance.

This is in line with the study conducted by Gupta et al., (2021) with observations on how the regulatory mandates affects consumer awareness. The survey also indicates that the extent of voluntary use of PAO labeling by brands outside the regulated markets is low since most companies use the expiry date to stay current with the local standards. This tends to pose some problems to multinational brands seeking to standardize their labeling procedures across various jurisdictions.

Other aspects the economy makes it even more challenging to implement PAO labeling. In most cases the costs that small and medium sized manufacturers bare to upgrade the labeling systems and to sensitize consumers can be massive. There is evidence from the literature by Jones & Lee (2023) showing that there is truth to this observation particularly arguing that firms Described above are the major difficulties companies encounter when trying to adopt PAO labeling. These challenges underscore the rationale for the of international standardized Guidelines, along with friendly financial policies that could encourage incentives for sustainability labeling.

Such analysis of trends, patterns and outliers highlights the potential role of PAO labeling in changing consumption patterns, improving safety of products and healing the planet. The results support most of the literature findings in asserting benefits of PAO labeling have been useful in increasing consumers' confidence and mitigating product wastage. However, the study also reveals some limitations such as the unequal spread of awareness across the regions, high cost of manufacturing and lack of harmonized regulations across the different regions. These issues will have to be resolved by the policy makers, heads of the companies and consumer organizations to make PAO labeling a global standard. In crossing these gaps, cosmetics industry can guarantee that the labeling procedures will change according to the new clientele with a focus on sustainability.

## **4.3 Discussion**

This last section relates the discoveries made in the data analysis procedures to the previously stated research aims, with regards to consumer safety, sustainability of the environment and policy suggestions. The results have shown that PAO labeling is a more effective approach to traditional expiry dating while identifying the difficulties that have to be overcome to utilize all the prospective of PAO labeling. Thus, when connecting the results with the research questions, we can draw understanding on how the PAO labeling affects the consumer behavior, product safety and environmental impacts.

### **4.3.1 Consumer Safety Implications**

Another major discovery from the present research work is that the consumption of PAO labels would be considered more credible than the conventional expiry dates. According to the study, 63% of consumers the use of the PAO labels assists consumers to make appropriate decisions regarding whether or not to continue using the cosmetic product particularly after the packaging has been opened (Rolston et al., 2021). This result is supported by prior studies that have found that PAO labeling decreases vulnerability to microbial intrusion and product spoilage since products such as mascaras and creams may easily get contaminated from exposure to air or fingers (Jones et al., 2023). According to the research, PAO labeling increases cosmetics usage confidence among customers because they are confident they are using the product within the safe and recommended period. In light of this finding, it can also be appreciated that consumer education may be critical in enhancing the effectiveness of PAO labels. However, it is widely observed that although EU-based consumers seemed to know better and trust more the PAO labels, other regional consumers are not very much familiar with the label and are thus exposed to safety hazards. Lack of conformity in consumers' information and enlightenment can create confusion, misuse or early disposal of the products in areas where PAO labeling is not required.

In order to enhance the consumer protection, manufacturers need to pay their attention to create an awareness about the importance of PAO labels. This may include short and concise labeling with an easily understandable layman language on pack-housings, short videos through QR codes linked to information on product shelf-life after opening. Further, the International organization should promote international harmonisation of the PAO labelling standards in a bid

to reduce confusion among the consumers regarding the safety of the labelled products (Smith et al., 2022).

#### **4.3.2 Environmental Sustainability**

The final finding of this study is that PAO labeling is linked with a decrease in product waste as 60% of the consumers claimed to finish products with labels until the products expired. This trend is seen in line with the increasing awareness of consumers' awareness of sustainability and environmental conservation (Lee et al., 2022). Since PAO labeling enables the consumer to get a clue when it is unsafe to use the product, the consumer is wary not to dispose of the cosmetic prematurely and possibly without necessity.

Thus, experts propose to improve offer of consumers PAO labels, noting that younger generations of millennials and Gen Z consumers increasingly actively respond to the opportunity to use an environmentally friendly product or service. Assuming the fact stated by Jones et al. (2023) and Martinez et al. (2021), consumers understand that brands using PAO labeling are environmentally friendly, which motivates the brand, loyalty and differentiation in the market. Moreover, companies that engage in PAO labelling are considered pioneers of sustainable strategies to encourage sustainable cosmetic packaging and the life cycle.

To sustain the development further, the manufacturers also need to invest on the PAO labeling systems and they should also have more serious attempts on minimizing their product wastes through providing packaging which are reusable and recyclable and providing proper channel to recycle. These governments and the other regulatory authorities should also follow the same example and set laws that will require all the producers of PAOs to label their products accordingly across more parts of the world in order to strive towards making the labeling around the world more unified. PAO labelling can be harmonised, thus simplifying the relations between the cosmetics market and sustainability objectives and decreasing the level of harm that cosmetics products cause to the environment (Lim et al., 2023).

#### **4.3.3 Policy Recommendations**

Perhaps one of the most important policy implications of this research project is the call for the standardization of the use of PAO labels across the globe. That is because while PAO labels are required in the EU, they are vetted in many other states, including the USA and Asian countries, which creates ambiguity and restricts the consumer's understanding of them (Gupta et al., 2021). Such a regulatory scenario is unproductive for multinational brands and simple consumer education becomes a difficult proposition. Therefore, independent bodies in various territories must entertain the idea of unification of labeling policies in order to simplify the use of PAO labels across all markets.

Referring to the European Union legislation and particularly the Cosmetic Products Regulation (EC) No 1223/2009 which offers labeling guidance for PAOs in products with a shelf-life period more than 30 months, a global framework for labeling of products containing PAOs can be proposed. This would go a long way to bring some order in differences in labeling practices so that consumers of products the world over are given as much information as is possible and in equal measure.

In symphony with these regulatory developments, there is a pressing need to educate the consumers. As was proved by this study, consumers' awareness of PAO labeling is substantially higher in the EU than in other countries, including the US and Asia. As for the former, the brands and policymakers in the packaged food industry should launch campaigns in order to enhance consumers' awareness of the use of PAO labelling in avoiding wastage of products and guaranteeing their safety. Writing articles and tutorials, using social networks, and labeling products will allow avoiding the risks of misunderstanding the benefits of using PAO labeling.

Last but not least, in order to popularise PAO labels, policy makers should provide rewards to companies using sustainable labelling systems. For instance incentives such as tax exemptions or trophies could be given to brands that use the PAO labeling in tandem with environmentally friendly packaging. Sustainability stamps might also be implemented to set expectations for supposedly green cosmetics, which would also matter for concerned consumers and motivate cosmetic companies to think about the environment and possible adverse effects on the human organism (Smith et al., 2022).

As the results of this research show, the application of PAO labeling appears to be highly promising as a tool to increase consumer protection, diminish product losses, and improve the state of the environment in terms of sustainability. However, the regional differences in consumers' awareness and policymakers' adherence to the regulation remain to be seen as the major issues. This study provides evidence to back up the proposition that, for the pro forma to reach its optimal potential and yield the wanted benefits, global standardization of PAO labeling is crucial, coupled with increased public awareness and sustainable labeling methods. Through making good policies to address these challenges, this study seeks to enhance both the quality and sustainable of cosmetics that are produced.

## 5 Conclusion

### 5.1 Key Findings

Using the case of the cosmetic industry, this research defines and establishes the benefits and drawbacks of the Period After Opening (PAO) labeling against the conventional expiry dates. One is the enhanced consumer acceptance and ease of use of PAO labels that are seen to enjoy a further degree of consumer trust where applied such as regions of the EU. This study argues that consumers consider PAO labels as a better signal of product safety and usability once opened with 63% of consumers undertaking to use products labeled with PAO. This may be especially true for products that are especially vulnerable to spoiling such as mascaras and sunblocks. On the other hand, expiry dates are disregarded as less applicable for products, which are opened from time to time or stored at different conditions.

Consumer awareness and understanding of PAO labelling is highlighted as a problem area, especially with large regional variation found in this study. As for the Europeans, 68% of them had notice of the PAO symbols in contrast to 34 percent in United States and 21 percent in Asia. This disparity shows that there is more reliance on the regulatory measures to influence tendencies and information among customers. The results indicate that PAO labeling in the EU has received strict regulatory requirements to enhance understanding and compliance compared to regions in which labeling enjoys optional status.

With regard to the environmental concern, PAO concludes that through exhibiting accurate information on the product lifespan of the product, the labels show how they are capable of

minimizing waste. More than half of the consumers agreed that they threw less cosmetics away when using products with PAO labels than those with expiry date only on their packaging, at 42%. This is especially important now, reflecting the increasing customer interest in the ecological aspects of products and services, especially among millennials. Further, the study reveals some of the issues concerning the dissimilarities between regulations across different countries that affect the implementation of the PAO labels to multinational brands. Some of these regulatory differences relate to labeling and disclosure, consumer information activities, and general market dynamism and competition.

## 5.2 Contributions to Knowledge

Evidently, this study advances knowledge on PAO labeling in the cosmetics industry in several ways. Through the comparison between the benefits of having PAO labels rather than expiry dates, it is highly informative on the specific aspects of such labeling systems in bridging the existing consumer safety, product functionality and environmental uses. Hence, the research helps in expanding a body of knowledge of consumer behaviour by identifying the effect of awareness and comprehension.jsx db Putting that into perspective, the research contributes towards building an understanding of consumer behavior concerning labeling systems, how awareness and understanding of such labeling systems determine the consumer's buying decision, their trust in the brand or product, and their disposal methods. The analysis of consumers preferences jeans regarding PAO labels has discovered some differences depending on the age and geographical location: Millennials and Global Green are more interested in those labels, and if speaking about the European Union it is completely logical since it has the strictest rules to label products.

Overall, the research also enriches the literature by try to identify effects of relationship between regulatory practices and consumer trust. This highlights the significance of standardized international policies on regulation of PAOs that may globally increase the standards for PAO labeling in order to increase consumer trust as well as decrease complexities encountered due to multi national organization dealing with multiple labeling requirements. Moreover, in doing so, the research enriches the body of knowledge on sustainable labelling to illustrate that PAO labels indeed promote waste minimisation and are linked to the objectives of sustainable industries.

In this study, consumer decision-making, product quality perception and regulatory compliance dimensions were conceptualised and these aspects provide a framework for ordering of labeling practices. Future studies, policies, and industry approaches focusing on optimizing labeling should use this framework. Due to the identified gaps within the current literature this work can serve to better inform future decision making processes for manufacturers, regulators, and consumers operating within the cosmetics market.

### **5.2.1.1 Limitations and Future Research**

This study has some limitations that should not be overlooked however; the study has made some significant contribution. One major limitation is the use of only secondary sources which reduces the effectiveness of collecting real consumer experiences. Although, the use of peer-reviewed articles, survey, industry reports helped to ensure credibility because the study lacked primary data sources like interviews, focus groups that would have provided rich insights of the consumer understanding of PAO labeling. More future research work should include collection of prime data to supplement the results established in this research work.

A third limitation can therefore be seen to be inherent in the geographic coverage of the study. While the study involved comparing and contrasting consumer behaviour between the EU, the US and Asia, the study lacks sufficient analysis on cultural/ demographic factors that may affect labelling attitudes. It would be even more enlightening if gender, income level, and cultural differences with regard to product safety and sustainability of products influence consumer's perception and behavior towards the PAO labels. It is therefore important that future research employ a cross cultural research design in order to investigate these variables in greater detail.

The research also points out the need to use panel data to determine the effect of PAO labeling on consumer decisions and the practices of the analysed industries in the long run. As it concisely, the research reveals preliminary customer approval of PAO labels in a restricted category; however, it is not apparent whether the customers will carry on using PAO labels or bring change in international regulations across global geographic regions. The future research should compare how there are changes over time in labeling innovations and evaluate the total cost benefits or loss to the economic and environment.

Eliminating these limitations and extending the existent literature may help the cosmetics industry come up with more efficient labeling practices that will correspond to the consumers' needs, existing regulations, and increase the concern for sustainability. This will also improve the application of PAO labeling for change making in the cosmetics sector and theoretical approaches used in its innovations.

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