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Consumer Understanding Of Chemical Labels And Product Composition Information

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Abstract

This study examines consumers' understanding of chemical labels and product composition information and their role in purchasing decisions. The study followed a quantitative research design and collected primary data from 300 consumers through a structured questionnaire. The questionnaire covered awareness of chemical labels, understanding of chemical names and ingredients, interpretation of chemical safety information, consideration of product composition, and purchasing decisions. The collected data were analysed using descriptive statistics, Pearson correlation, and analysis of variance. The findings show that consumers generally reported awareness of chemical information provided on product labels. A strong positive and significant relationship was found between awareness of chemical labels and the ability to understand product composition information ($r = 0.889$, $p = 0.000$). A significant positive relationship was also found between understanding chemical labels and interpreting chemical safety information ($r = 0.524$, $p = 0.000$). ANOVA further showed significant differences in purchasing decisions based on consideration of product composition ($F = 14.198$, $p = 0.000$).

Keywords; Chemical Labels, Product Composition, Consumer Awareness, Chemical Safety, Purchasing Decisions

INTRODUCTION

Chemical labels and product composition information provide consumers with important details about the substances contained in everyday products. Such information may include ingredients, warnings, directions for use, storage conditions, and possible risks. Consumers often encounter these labels on cosmetics, cleaning products, packaged foods, medicines, and other household goods (Olisah et al., 2025). However, the presence of technical chemical names and unfamiliar terms can make the information difficult to understand. Proper understanding of labels can help consumers make informed choices, use products safely, and avoid substances to which they may be sensitive (Chang & Chen, 2022). Thus, examining how consumers read, understand, and use chemical label information is important for assessing their awareness and purchasing behaviour.

Chemical Labels in Consumer Products

Chemical labels on consumer products serve as an important source of information about the chemical substances, mixtures, and associated hazards present in a product. Depending on the nature of the product, labels may provide the names of chemical ingredients, active substances, concentration or composition details, hazard statements, precautionary information, storage requirements, and appropriate handling instructions (Australia, 2022). From a chemistry perspective, such information helps consumers identify the chemical nature and intended function of product constituents, while hazard symbols and warnings communicate potential risks associated with toxicity, corrosiveness, flammability, irritation, or other hazardous properties. The usefulness of chemical labelling therefore depends not only on the completeness of the information but also on the consumer's ability to recognise and interpret chemical terminology and safety information (Ssumptions et al., 2013).

Table 1 Chemical Information Commonly Provided on Consumer Product Labels

Chemical Information	Relevance to Consumers
Chemical or ingredient name	Identifies the substance present in the product
Active ingredient	Indicates the chemical component responsible for the principal function of the product
Concentration or composition	Provides information about the amount or proportion of a chemical constituent
Hazard classification	Indicates the type and nature of chemical hazard
Hazard symbols	Provides a visual indication of specific chemical risks
Hazard statements	Describes the potential harmful effects associated with the substance or mixture
Precautionary statements	Provides information on safe handling, use, storage, and disposal
Physical state	Indicates whether the product is present as a solid, liquid, gel, aerosol, or other form
Storage conditions	Specifies conditions necessary to maintain chemical stability and safety
First-aid information	Provides initial measures following accidental exposure or contact
Manufacturer or supplier information	Identifies the source responsible for the chemical product and its labelling

Product Composition Information and Consumer Decision-Making

Product composition information describes the chemical constituents present in a consumer product and provides a basis for understanding its functional properties, potential hazards, and suitability for particular uses. From a chemistry perspective, consumers may encounter information about active ingredients, solvents, preservatives, surfactants, acids, bases, fragrances, colouring agents, stabilisers, or other chemical constituents. The ability to interpret such information can influence how consumers compare products and assess their suitability, particularly when safety, sensitivity, environmental concerns, or intended chemical function is important.

Consumers may consider composition information in several ways (Asioli et al., 2017):

- **Ingredient identification:** Recognising the substances present in a product.
- **Chemical function:** Understanding the purpose of particular ingredients.
- **Concentration:** Considering the amount or proportion of important chemical constituents.
- **Safety assessment:** Identifying substances associated with specific chemical hazards.
- **Product comparison:** Comparing the composition of different products before purchase.
- **Suitability:** Selecting products according to individual requirements or intended use.
- **Avoidance of unwanted substances:** Checking labels for particular chemicals that consumers prefer to avoid.

Clear composition information can therefore connect chemical knowledge with practical consumer choices. However, unfamiliar chemical names and technical terminology may limit the effective use of such information.

Table 2 Chemical Composition Factors Relevant to Consumer Decision-Making

Composition Factor	Chemical Significance	Possible Influence on Consumer Decision
Active ingredients	Determine the principal chemical action of the product	Helps assess functional suitability
Ingredient identity	Establishes the chemical substances present	Helps consumers identify preferred or unwanted substances
Concentration	Indicates the relative amount of a constituent	May assist in comparing product formulations
Preservatives	Help control chemical or microbial deterioration	May influence consumers concerned about particular additives
Surfactants	Affect cleaning, wetting, foaming, or emulsification	Helps explain product performance
Acids and bases	Influence pH and chemical reactivity	May be relevant to safety and intended application
Solvents	Dissolve or disperse other components	Can affect product properties and handling requirements
Fragrances and colourants	Provide sensory characteristics	May influence preferences and ingredient avoidance
Stabilising agents	Help maintain formulation stability	May contribute to product shelf stability
Hazardous constituents	May possess toxic, corrosive, irritant, or flammable properties	Can influence safety-related purchasing decisions

Consumer Awareness and Interpretation of Product Labels

Consumer awareness of product labels refers to the extent to which individuals notice, read, understand, and use the chemical and safety information provided on product packaging. From a chemistry perspective, interpretation involves recognising ingredient names, chemical functions, concentration information, hazard symbols, warning statements, and precautionary instructions. Consumers with greater familiarity with basic chemical terminology may be better able to distinguish between active and inactive constituents, identify potentially hazardous substances, and understand the significance of specific warnings. However, complex nomenclature, small print, unfamiliar abbreviations, and technical terminology can create difficulties in interpreting chemical information (Dionisio et al., 2018). Therefore, awareness should be considered not merely as the ability to read a label, but also as the ability to relate the information provided to the chemical properties, intended use, and potential risks of the product.

Consumer interpretation of chemical labels commonly involves (Matlhare, 2024):

i. **Reading ingredient names:** Identifying the chemical substances listed on the label.
ii. **Recognising chemical functions:** Understanding why particular substances are incorporated into the formulation.
iii. **Interpreting hazard information:** Relating symbols and warnings to possible chemical risks.
iv. **Understanding concentration information:** Interpreting quantities or proportions of important constituents.
v. **Following precautionary instructions:** Applying recommended measures for safe handling and use.
vi. **Identifying storage requirements:** Understanding conditions that may affect chemical stability or safety.
vii. **Using information during purchase:** Applying label information when comparing alternative products.

LITERATURE REVIEWS

(Buchmüller et al., 2020) When it comes to using chemical home items, there are a lot of ways to get the average person to think twice. Consumers do not appear to automatically consider the hazards connected with chemical household products, so it is crucial to educate them on these risks at every stage of their handling, including purchase, storage, use, and disposal. It appears prudent to construct the items in a manner that continually alerts the user to the dangers associated with using them, as chemical home products may cause errors not only during use but also during buying, storage, and disposal. One way to do this would be to use bigger warning images or symbols on the front of the packaging and labels instead of the smaller pictograms seen on the back of the items. Secondly, it seems that there is a lack of public information of fundamental toxicological concepts. Indeed, manmade substances seem to inspire a great deal of dread. Consumers may take more effective safety precautions if they are better educated, it appears. Third, there are a number of elements that are associated with how serious people consider potentially dangerous circumstances to be. These include things like chemophobia, behavioural obstacles, self-evaluation of one's own behaviour in comparison to others, and personal risk awareness. Ultimately, these reasons might motivate people to modify their behaviour for the better and be safer.

(Luchsinger & Bearth, 2026) The objectives of the study were to classify consumers according to their risk tolerance and product preferences, to determine the prevalence of optimistic bias and biasing beliefs in the handling of chemicals, and to analyse two chosen strategies for reducing risk, namely the use of alternatives and the inclusion of risk information on product packaging. Consumers from all around Switzerland participated in an online survey (N = 996) that was facilitated by a market research firm. A four-cluster solution was proposed via cluster analysis. The findings reveal that there are two groups, with a larger percentage of younger individuals, who value product efficacy and usability more than safety. Members of a more senior demographic made up one group that prioritised security. Many demographics of consumers possess prejudiced views on the safe usage of common home chemicals. Members' assessments of the probability of an accident occurring in their own home were significantly related to cluster membership. Both groups were more likely to use the two risk-reduction tactics when they were very concerned about a product's safety. The need of developing segmented risk communication strategies is shown by these results. Improving safe handling procedures requires raising public knowledge of GHS and encouraging alternatives to commercial chemical goods.

(Hosni et al., 2024) With the existing textual labelling approach in place, consumers may incorrectly assume that over-the-counter pesticides pose no health risks, which might result in their inappropriate use. The authors tested three different pesticide label alternatives: traffic light

colours and skull intensity symbols against the present standard: Caution, Warning, Danger, through an incentivised framed field experiment with eye tracking. The 166 participants were given one of three label types at random and then asked to rate the levels of toxicity and choose an item from among several pricing lists. Based on the results, signal words are not effective in conveying levels of toxicity. More specifically, when presented with the traffic light and skull intensity symbol labels, participants' accuracy in determining toxicity level increases from 54% under the previous signal word label to 95% and 83%, respectively. Another finding is that participants preferred to choose the less harmful options when given the new labels, which might mean that the way things are labelled is influencing their choices and potentially harming people in ways we didn't anticipate.

(Roonnaphai et al., 2024) The purpose of the research was to identify the elements linked to the understanding of chemical danger labels as they pertain to the globally harmonised system of chemical categorisation and labelling (GHS). A total of 310 people from Bangkok participated in the survey. We polled people on their demographics, how often they use items containing potentially harmful chemicals, and how well they understood and applied GHS labels. Among the subjects, only 11.9% shown competent level of proper perception of GHS labels and 11.6% demonstrated proficient level of understanding, according to the data. Working in the public or private sector, having a good grasp of the GHS labels, and having skilled perception of the labels were all significantly correlated. In order to lessen the likelihood of harm from potentially dangerous chemical home items, this study's findings may inform the creation of better risk communication techniques that inform customers of product risks.

(Joshi et al., 2022) Companies are now using less damaging alternatives due to consumer knowledge. Concerns about the safety of several chemical compounds—including preservatives in cleaning agents and scents in personal care products—in everyday home items have grown in recent years due to growing consumer knowledge of these chemicals. As people have become more conscious of the dangers of chemicals, this has also emerged as a major concern. The current research used a convenience sample technique to administer a well-structured questionnaire to one hundred customers in Uttarakhand's Nainital District. The results showed that most people really cared about the possibility that the chemicals in the things they used on a daily basis had an impact on their health and the environment.

RESEARCH GAP

Previous studies have mainly examined consumers' awareness of chemical risks, comprehension of hazard labels, risk communication, and safe handling of chemical products. Buchmüller et al. (2020) highlighted limited awareness of chemical risks, while Roonnaphai et al. (2024) reported low levels of perception and comprehension of GHS labels. Joshi et al. (2022) found considerable consumer concern about chemicals in everyday products, whereas Hosni et al. (2024) showed that clearer visual risk information can improve understanding of toxicity. Luchsinger and Bearth (2026) further reported differences in consumers' safety-related preferences and use of risk-reduction strategies. However, limited empirical attention has been given to the connection between awareness of chemical labels, understanding of product composition, interpretation of chemical safety information, and the role of such information in purchasing decisions. This gap indicates the need to examine these aspects together among consumers.

OBJECTIVES OF THE STUDY

i. To study the consumer awareness regarding chemical labels and product composition information.
ii. To examine consumers' understanding and interpretation of chemical names, ingredients, concentrations, hazard symbols, and safety instructions.
iii. To analyse the relationship between consumers' awareness of chemical labels and their ability to understand product composition information.
iv. To examine the influence of consumers' consideration of product composition on their purchasing decisions.

HYPOTHESES OF THE STUDY

- **H_{01}:** There is no significant relationship between consumers' awareness of chemical labels and their ability to understand product composition information.
- **H_{02}:** There is no significant relationship between consumers' understanding of chemical labels and their ability to interpret chemical safety information.
- **H_{03}:** Consumers' consideration of product composition has no significant influence on their purchasing decisions.

RESEARCH METHODOLOGY

The study adopted a descriptive and empirical research design to examine consumers' awareness, understanding, interpretation, and use of chemical label and product composition information. A structured questionnaire was used as the primary tool for collecting data from consumers, and a total of 300 responses were collected for the study. The questionnaire included questions relating to respondents' awareness of chemical labels, understanding of chemical names and ingredients, interpretation of concentrations, hazard symbols and safety instructions, and consideration of product composition during purchasing decisions. The collected responses were organised and analysed using suitable statistical techniques to examine the relationships specified in the hypotheses. The study used a quantitative approach, with responses measured through appropriate categorical and five-point Likert-scale items.

Table 3 Research Methodology of the Study

Methodological Component	Description
Research approach	Quantitative
Research design	Descriptive and empirical
Nature of study	Consumer-based study
Population	Consumers using labelled consumer products
Sample size	300 respondents
Sampling method	Convenient sampling
Data collection tool	Structured questionnaire
Primary variables	Chemical label awareness, understanding of chemical information, chemical safety interpretation, consideration of product composition, purchasing decisions
Scale of measurement	Categorical and five-point Likert scale
Nature of data	Primary data
Data analysis	Descriptive statistics and hypothesis testing
Basis of analysis	Responses obtained from 300 consumers

DATA ANALYSIS AND INTERPRETATION

The data collected from 300 respondents through the structured questionnaire were organised and analysed to examine consumers' awareness, understanding, and use of chemical label and product composition information. The analysis presents the demographic profile of the respondents, descriptive results for the study variables, and the statistical tests used to examine the hypotheses. Frequencies, percentages, mean scores, standard deviations, correlation analysis, and analysis of variance were used as appropriate. The findings are presented in tables and interpreted based on the responses obtained from the respondents.

Table 4 Age

Age					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-25 years	66	22.0	22.0	22.0
	25-35 years	71	23.7	23.7	45.7
	36-45 years	116	38.7	38.7	84.3
	Above 45 years	47	15.7	15.7	100.0
	Total	300	100.0	100.0	

Among the 300 respondents, the highest proportion belonged to the 36–45 years age group, comprising 116 respondents (38.7%). This was followed by respondents aged 25–35 years, with 71 respondents (23.7%), while 66 respondents (22.0%) were in the 18–25 years category. The above 45 years group accounted for 47 respondents (15.7%). Thus, the frequency distribution shows that respondents aged 36–45 years constituted the largest group in the study, whereas those above 45 years represented the smallest proportion.

Table 5 Gender

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	160	53.3	53.3	53.3
	Female	140	46.7	46.7	100.0
	Total	300	100.0	100.0	

The gender distribution shows that 160 respondents (53.3%) were male, while 140 respondents (46.7%) were female. Thus, male respondents constituted a slightly higher proportion of the study participants than female respondents. The frequencies indicate that both groups were represented in substantial proportions among the 300 respondents.

Table 6 Educational Qualification

Educational Qualification					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Up to Higher Secondary	32	10.7	10.7	10.7
	Graduate	157	52.3	52.3	63.0
	Postgraduate	66	22.0	22.0	85.0
	Others	45	15.0	15.0	100.0
	Total	300	100.0	100.0	

The educational qualification distribution shows that 157 respondents (52.3%) were graduates, representing the largest proportion of the respondents. This was followed by 66 respondents (22.0%) who were postgraduates, while 45 respondents (15.0%) belonged to the 'Others' category. A total of 32 respondents (10.7%) had education up to the higher secondary level. Thus, graduates constituted the

largest group among the 300 respondents, whereas respondents with education up to higher secondary represented the smallest proportion.

Table 7 Descriptive Statistics

Descriptive Statistics					
	N	**Min**	**Max**	**Mean**	**S.D.**
I am aware that consumer products contain different chemical ingredients.	300	1	5	3.22	1.442
I pay attention to chemical information provided on product labels.	300	1	5	2.01	1.135
I am aware of the purpose of ingredient information given on product labels.	300	1	5	1.88	1.071
I can recognise basic chemical names or ingredient names mentioned on product labels.	300	1	5	1.96	1.186
I am aware that chemical labels provide information related to the safe use of products.	300	1	5	2.60	1.556
I can understand the ingredient list provided on consumer products.	300	1	5	2.85	1.462
I can identify the main chemical ingredients present in a product from its label.	300	1	5	2.08	1.240
I can understand information about the concentration or proportion of ingredients when provided.	300	1	5	2.11	1.424
I can distinguish between different types of chemical ingredients based on the information provided on the label.	300	1	5	2.22	1.348
I can understand the basic chemical composition of a product from its label.	300	1	5	2.33	1.410
I understand the meaning of common chemical terms used on product labels.	300	1	5	2.61	1.469
I understand the information provided about active and other ingredients on product labels.	300	1	5	2.03	1.178
I understand the meaning of chemical hazard symbols displayed on product labels.	300	1	5	2.34	1.355
I understand the warnings and precautionary information given on chemical product labels.	300	1	5	2.27	1.336
I can relate the chemical information on a product label to its intended use.	300	1	5	2.33	1.429
I can understand safety warnings related to chemicals present in consumer products.	300	1	5	2.83	1.492
I can identify possible chemical hazards from the information provided on a product label.	300	1	5	2.10	1.244
I can understand precautions for the safe handling and use of chemical products.	300	1	5	2.12	1.343
I can understand storage instructions provided for products containing chemical substances.	300	1	5	2.10	1.335
I can understand what action should be taken when a product label provides a chemical safety warning.	300	1	5	2.31	1.415
I check the chemical ingredients of a product before purchasing it.	300	1	5	2.61	1.430
I consider the presence of specific chemicals when selecting a product.	300	1	5	2.02	1.129
I compare the composition of similar products before making a purchase.	300	1	5	2.26	1.237
I avoid products containing chemical ingredients that I prefer not to use.	300	1	5	2.26	1.333
The chemical composition of a product is an important consideration when I decide whether to purchase it.	300	1	5	2.34	1.415
Chemical information on a product label influences my decision	300	1	5	2.43	1.562

to purchase the product.					
I am more likely to purchase a product when its chemical information is clearly provided.	300	1	5	2.33	1.391
I reconsider purchasing a product when its chemical composition is unclear.	300	1	5	2.13	1.106
I compare chemical information before choosing between similar products.	300	1	5	2.09	1.190
Information about the chemical contents of a product contributes to my final purchasing decision.	300	1	5	2.75	1.518
Valid N (listwise)	300				

The descriptive statistics of the 30 statements were analysed using the five-point Likert scale, where 1 indicates Strongly Agree and 5 indicates Strongly Disagree. For awareness of chemical labels, the lowest mean score was 1.88 for awareness of the purpose of ingredient information, while awareness that consumer products contain different chemical ingredients recorded the highest mean of 3.22. For understanding product composition, the mean scores ranged from 2.08 to 2.85, with the lowest score for identifying the main chemical ingredients from product labels and the highest for understanding ingredient lists. In the case of understanding chemical labels, the mean scores ranged from 2.03 to 2.61. For chemical safety information, the mean scores varied between 2.10 and 2.83, with identifying possible chemical hazards and understanding storage instructions recording relatively lower mean scores.

For consideration of product composition, the mean scores ranged from 2.02 to 2.61, while the purchasing decision statements recorded mean scores between 2.09 and 2.75. The standard deviation values ranged from 1.071 to 1.562, showing some variation in the responses of the 300 participants. Since lower mean values represent stronger agreement on the scale used in the study, the results indicate that respondents generally agreed with most of the statements, although the level of agreement differed across the individual aspects examined.

Hypotheses testing

H_{01}: There is no significant relationship between consumers' awareness of chemical labels and their ability to understand product composition information.

Correlations			
		Consumers' Awareness of Chemical Labels	**Consumers' Ability to Understand Product Composition Information**
Consumers' Awareness of Chemical Labels	Pearson Correlation	1	.889**
	Sig. (2-tailed)		.000
	N	300	300
Consumers' Ability to Understand Product Composition Information	Pearson Correlation	.889**	1
	Sig. (2-tailed)	.000	
	N	300	300
**. Correlation is significant at the 0.01 level (2-tailed).			

The Pearson correlation analysis was used to examine the relationship between consumers' awareness of chemical labels and their ability to understand product composition information. The analysis was based on 300 respondents. The results show a Pearson correlation coefficient of 0.889 with a significance value of 0.000. This indicates a strong positive relationship between the two variables. Since the significance value is less than 0.01, the relationship is statistically significant. Therefore, the null hypothesis (H01) is rejected. The finding indicates that consumers with greater awareness of chemical labels tend to have a higher ability to understand product composition information.

H_{02}: There is no significant relationship between consumers' understanding of chemical labels and their ability to interpret chemical safety information.

Correlations			
		Consumers' Understanding of Chemical Labels	**Consumers' Ability to Interpret Chemical Safety Information**
Consumers' Understanding of Chemical Labels	Pearson Correlation	1	.524**
	Sig. (2-tailed)		.000
	N	300	300
Consumers' Ability to Interpret Chemical Safety Information	Pearson Correlation	.524**	1
	Sig. (2-tailed)	.000	
	N	300	300
**. Correlation is significant at the 0.01 level (2-tailed).			

The Pearson correlation analysis was conducted to examine the relationship between consumers' understanding of chemical labels and their ability to interpret chemical safety information. The analysis was based on 300 respondents. The results show a Pearson correlation

coefficient of 0.524 with a significance value of 0.000. This indicates a moderate positive relationship between the two variables. Since the significance value is less than 0.01, the relationship is statistically significant. Therefore, the null hypothesis (H02) is rejected. The finding indicates that consumers who have a better understanding of chemical labels also tend to have a better ability to interpret chemical safety information.

H_{03}: Consumers' consideration of product composition has no significant influence on their purchasing decisions.

ANOVA					
Consumers' Purchasing Decisions					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	711.517	12	59.293	14.198	.000
Within Groups	1198.520	287	4.176		
Total	1910.037	299			

A one-way analysis of variance (ANOVA) was conducted to examine whether consumers' consideration of product composition has a significant influence on their purchasing decisions. The analysis was based on 300 respondents. The results show an F-value of 14.198 with a significance value of 0.000. Since the significance value is less than 0.05, the difference between the groups is statistically significant. Therefore, the null hypothesis (H03) is rejected. The finding indicates that consumers' purchasing decisions differ significantly according to their level of consideration of product composition. This suggests that consideration of chemical composition is significantly associated with consumers' purchasing decisions.

CONCLUSION

The study examined consumers' awareness and understanding of chemical labels and product composition information and their role in purchasing decisions. The findings show that respondents were generally aware of chemical information provided on consumer product labels. They also showed a reasonable level of understanding of chemical ingredients, product composition, hazard information, warnings, and safety instructions. However, the responses indicate that the level of understanding was not the same for all types of information, particularly where technical chemical terms and detailed composition information were involved. The study further found a strong positive relationship between consumers' awareness of chemical labels and their ability to understand product composition information, with a Pearson correlation of 0.889 and a significance value of 0.000. A significant positive relationship was also found between understanding chemical labels and the ability to interpret chemical safety information, with a correlation of 0.524 and a significance value of 0.000. In addition, the ANOVA result showed a significant difference in purchasing decisions according to consumers' consideration of product composition ($F = 14.198$, $p = 0.000$). The findings indicate that chemical information on product labels has an important place in consumer understanding and purchasing decisions. Clear and understandable chemical information can therefore help consumers make more informed choices.

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