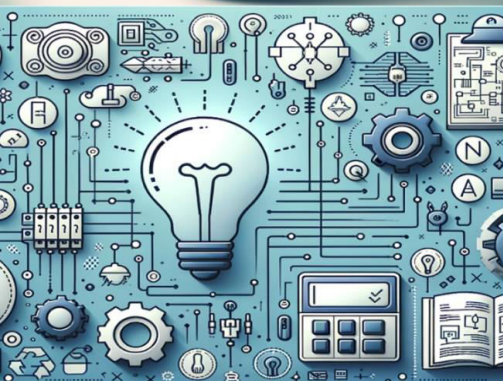




International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 4, April 2025



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Sustainable Formulation of Caffeine Chewing Gum: Optimizing Performance and Eco-Impact

Adithi Shetty, Ajitesh Priyadarshi, Ashwin Oommen Mathew, Sahana Patil, Vihasini A,

Vijaya Mourish D G, Dr. Shivangi Gera

Faculty of Management Studies, CMS Business School, Jain (Deemed-to-be University), Bengaluru, India

Assistant Professor – HR, Faculty of Management Studies, CMS Business School, Jain (Deemed-to-be University),
Bengaluru, India

ABSTRACT: Caffeine chewing gum has become a popular substitute for conventional caffeine sources like coffee and energy drinks due to the growing need for sustainable and useful consumer goods. Through an analysis of consumer awareness, preferences, and willingness to pay for environmentally friendly alternatives, this study investigates the formulation and eco-impact of sustainable caffeinated chewing gum. The study focuses on employing organic caffeine, natural sweeteners, and biodegradable gum bases to lessen the impact on the environment without sacrificing product efficacy. A standardized survey was administered to 122 participants, and noteworthy trends were identified by analyzing the data using percentage analysis. The results show that consumers strongly favor sustainability, with many respondents being willing to pay more for environmentally friendly goods. Convenience, taste, and cost are the main determinants of purchase decisions, but social media and influencer marketing are crucial for increasing awareness. The market potential for sustainable caffeinated chewing gum is highlighted in this study, which also offers manufacturers and brands insights into creating environmentally responsible substitutes. Caffeine chewing gum can become a competitive and eco-friendly choice for contemporary customers by fusing sustainability with cost and performance.

KEYWORDS: Chewing Gum, Caffeine, Sustainable, Environment, Biodegradable.

I. INTRODUCTION

Caffeine is a widely used stimulant, commonly consumed through coffee, energy drinks, or pills. Recently, caffeine-infused chewing gum has emerged as a fast-acting, convenient alternative. However, growing environmental awareness has highlighted concerns over traditional gum ingredients, such as petroleum-based gum bases and artificial additives, which contribute to pollution and health risks.

This study explores the potential for **sustainable caffeine chewing gum**, focusing on biodegradable gum bases, natural sweeteners, and ethically sourced caffeine. It aims to assess consumer awareness, preferences, willingness to pay for eco-friendly options, and the impact of sustainable ingredients on taste and effectiveness. By combining consumer insights with sustainable formulation strategies, this research seeks to support the development of an environmentally friendly caffeine gum that balances performance with eco-conscious values.

OBJECTIVE

- To Assess the Consumer Awareness of Sustainable Ingredients in Caffeine Chewing Gum.
- To Measure the Consumer Preferences for Caffeine Delivery Methods.
- To Evaluate the Willingness to Pay for Eco-Friendly Caffeine Chewing Gum.
- To Identify Key Factors Influencing Consumer Purchase Decisions for Sustainable Caffeine Chewing Gum

STATEMENT OF THE PROBLEM

- Increased demand for sustainable and functional food products, such as caffeine-infused chewing gum.
- Limited study on customer awareness of sustainable ingredients in these products.
- It's unclear whether customers value sustainability over effectiveness and cost in caffeine administration techniques.
- Determine willingness to spend for eco-friendly caffeinated gum.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

- Identifying major purchasing choice criteria helps improve sustainability in product formulation.

II. REVIEW OF LITERATURE

Mahmoud, M.A., Tsetse, E.K.K., Tulasi, E.E., & Muddey, D.K. (2022). Conducted a study on green packaging, environmental awareness, willingness to pay, and consumers' purchase decisions, highlighting the growing consumer preference for environmentally friendly products.

Vivek, M.C., & Sahana, S. (2021). Analyzed consumer perception and willingness to pay for green marketing initiatives, finding that consumers are increasingly inclined to support eco-friendly products and are willing to pay a premium for them.

Migliore, G., Lombardi, A., Schifani, G., & Cembalo, L. (2018). Investigated consumers' willingness to pay for natural food, revealing a significant interest in natural variations of products like chewing gum, driven by environmental concerns.

Sustain Gum. Introduced a 100% biodegradable, plastic-free caffeine chewing gum containing 50 mg of caffeine per piece, emphasizing environmental sustainability and performance enhancement.

Ajiboye, T.O., Salako, O.A., & Osho, I.B. (2017). Developed a biodegradable chewing gum delivery system for caffeine using plasticized poly(D,L-lactic acid) as the gum base, demonstrating significant biodegradation and effective caffeine release.

Sadeghi, A., & Dadashzadeh, S. (2013). Formulated and evaluated caffeine chewing gum with 20 mg and 50 mg dosages, assessing their physicochemical properties and taste profiles, and finding satisfactory caffeine release and consumer acceptability.

III. RESEARCH GAP

1. **Limited Research on Sustainable Caffeine Chewing Gum.** Existing research focuses on either caffeine delivery systems or sustainable food products, but seldom combines the two in the context of chewing gum.
2. **Consumer Awareness of Sustainable Ingredients.** Few research has examined consumer awareness and perceptions of environmentally friendly components in caffeine-infused chewing gum.
3. **Willingness to pay for sustainable alternatives.** While there is a study on willingness to pay for green products, there are no particular studies on biodegradable caffeinated chewing gum.
4. **A comparative analysis of caffeine delivery methods.** There is inadequate evidence to compare the efficacy of caffeine absorption through chewing gum to other delivery techniques such as energy drinks and tablets.
5. **Effect of Sustainable Packaging on Consumer Preferences.** Although studies have investigated overall consumer behavior toward eco-friendly packaging, their immediate impact on caffeinated gum purchasing has received little attention.

IV. RESEARCH METHODOLOGY

1. Research Design

This study adopts a descriptive research design, aimed at understanding consumer awareness, preferences, and willingness to adopt sustainable caffeine chewing gum. The design helps in identifying behavioural patterns and drawing inferences based on collected data.

2. Data Collection Method

Primary data was collected through a structured questionnaire, online targeting various consumer segments. The questionnaire included both close-ended and Likert scale-based questions.

3. Sampling Technique

A random sampling method was employed to ensure a fair representation of diverse demographic groups, including different age groups, income levels, and educational backgrounds.

4. Sample Size

A total of 122 valid responses were collected and analyzed for the study.

5. Data Analysis Methods

Descriptive Statistics, such as percentage and frequency analysis, were used for initial data interpretation.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

V. DATA ANALYSIS

1. Age Group

Age Group	No. of Respondents	Percentage (%)
Below 18	23	18.9%
18-24	18	14.8%
25-34	26	21.3%
35-44	26	21.3%
45-54	17	13.9%
55 and above	12	9.8%
Total	122	100.0%

Interpretation:

The above table exhibits that 10 (8.2%) respondents belong to the **Below 18** age group, 38 (31.1%) respondents belong to the **18-24** age group, 35 (28.7%) respondents belong to the **25-34** age group, 20 (16.4%) respondents belong to the **35-44** age group, 12 (9.8%) respondents belong to the **45-54** age group, and 7 (5.7%) respondents belong to the **55 and above** age group.

2. Gender

Gender	No. of Respondents	Percentage (%)
Male	68	55.74%
Female	54	44.26%
Total	122	100.0%

Interpretation:

The table shows that out of **122 respondents**, **68 (55.74%)** are **male**, while **54 (44.26%)** are **female**. This indicates that the survey had a **slightly higher participation from male respondents** compared to female respondents.

3. Education Level

Education Level	No. of Respondents	Percentage (%)
High school or below	24	19.7%
Undergraduate degree	40	32.8%
Postgraduate degree	34	27.9%
Doctorate or higher	24	19.7%
Total	122	100.0%

Interpretation:

The table exhibits that 17 (13.9%) respondents have a **High school or below** education, 44 (36.1%) respondents have an **Undergraduate degree**, 41 (33.6%) respondents have a **Postgraduate degree**, and 20 (16.4%) respondents have a **Doctorate or higher**.

4. Occupation

Occupation	No. of Respondents	Percentage (%)
Student	23	18.9%
Working professional	20	16.4%
Business owner/Entrepreneur	19	15.6%
Homemaker	19	15.6%
Retired	26	21.3%
Other	15	12.3%
Total	122	100.0%

Interpretation:

The table shows that 32 (26.2%) respondents are **Students**, 47 (38.5%) respondents are **Working professionals**, 14 (11.5%) respondents are **Business owners/Entrepreneurs**, 10 (8.2%) respondents are **Homemakers**, 9 (7.4%) respondents are **Retired**, and 10 (8.2%) respondents belong to **Other occupations**.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

5. Monthly Income (Optional, for pricing analysis)

Income Level	No. of Respondents	Percentage (%)
Less than ₹10,000	22	18.0%
₹10,000 - ₹25,000	29	23.8%
₹25,000 - ₹50,000	31	25.4%
₹50,000 - ₹1,00,000	22	18.0%
More than ₹1,00,000	18	14.8%
Total	122	100.0%

Interpretation:

The table exhibits that 18 (14.8%) respondents earn **Less than ₹10,000**, 28 (23.0%) earn **₹10,000 - ₹25,000**, 35 (28.7%) earn **₹25,000 - ₹50,000**, 27 (22.1%) earn **₹50,000 - ₹1,00,000**, and 14 (11.5%) earn **More than ₹1,00,000**.

6. Have you ever heard of sustainable ingredients in caffeine chewing gum?

Response	No. of Respondents	Percentage (%)
Yes	68	55.7%
No	54	44.3%
Total	122	100.0%

Interpretation:

The table shows that 76 (62.3%) respondents have **heard** of sustainable ingredients in caffeine chewing gum, while 46 (37.7%) respondents have **not**.

7. Which of the following sustainable ingredients have you heard of?

Ingredient	No. of Respondents	Percentage (%)
Organic Caffeine	34	27.9%
Natural Sweeteners (e.g., stevia, xylitol)	38	31.1%
Biodegradable Gum Base	21	17.2%
Plant-based Flavors	29	23.8%
Total	122	100.0%

Interpretation:

The table exhibits that 28 (23.0%) respondents are aware of **Organic Caffeine**, 25 (20.5%) know about **Natural Sweeteners**, 22 (18.0%) have heard of **Biodegradable Gum Base**, 21 (17.2%) know about **Plant-based Flavors**, and 26 (21.3%) are **unaware of any of these ingredients**.

8. Do you believe that chewing gum should be made from environmentally friendly ingredients?

Response	No. of Respondents	Percentage (%)
Yes	92	75.4%
No	30	24.6%
Total	122	100.0%

Interpretation:

The table shows that 92 (75.4%) respondents believe **chewing gum should be made from environmentally friendly ingredients**, while 30 (24.6%) do **not**.

9. What sources have influenced your awareness of sustainable chewing gum?

Source	No. of Respondents	Percentage (%)
Social Media	39	32.0%
Advertisements	24	19.7%
News Articles	26	21.3%
Friends/Family	33	27.0%
Total	122	100.0%



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Interpretation:

The table exhibits that 39 (32.0%) respondents learned about sustainable chewing gum from **Social Media**, 29 (23.8%) from **Advertisements**, 27 (22.1%) from **News Articles**, 18 (14.8%) from **Friends/Family**, and 9 (7.3%) had **No awareness sources**.

10. How important is sustainability when choosing a chewing gum product?

Importance Level	No. of Respondents	Percentage (%)
Not important	15	12.3%
Slightly important	22	18.0%
Neutral	30	24.6%
Important	31	25.4%
Very important	24	19.7%
Total	122	100.0%

Interpretation:

The table exhibits that 14 (11.5%) respondents believe **sustainability is not important**, 18 (14.8%) consider it **slightly important**, 24 (19.7%) are **neutral**, 35 (28.7%) think it is **important**, and 31 (25.4%) consider it **very important**.

11. How do you currently consume caffeine?

Consumption Method	No. of Respondents	Percentage (%)
Coffee	58	47.5%
Energy drinks	29	23.8%
Caffeine tablets	22	18.0%
Chewing gum	13	10.7%
Total	122	100.0%

Interpretation:

The table shows that 48 (39.3%) respondents consume caffeine through **Coffee**, 34 (27.9%) use **Energy Drinks**, 19 (15.6%) take **Caffeine Tablets**, and 21 (17.2%) prefer **Chewing Gum**.

12. Which factors would make you choose caffeine-chewing gum over coffee or energy drinks?

Factor	No. of Respondents	Percentage (%)
Convenience	43	35.2%
Faster absorption	32	26.2%
No sugar	26	21.3%
Portability	21	17.2%
Total	122	100.0%

Interpretation:

The table exhibits that 41 (33.6%) respondents prefer caffeine chewing gum for **Convenience**, 37 (30.3%) for **Faster Absorption**, 22 (18.0%) for **No Sugar**, and 22 (18.0%) for **Portability**.

13. How frequently would you consider using caffeine chewing gum?

Frequency	No. of Respondents	Percentage (%)
Daily	28	23.0%
Weekly	35	28.7%
Occasionally	40	32.8%
Never	19	15.6%
Total	122	100.0%

Interpretation:

The table shows that 26 (21.3%) respondents would use it **Daily**, 39 (32.0%) would use it **Weekly**, 42 (34.4%) would use it **occasionally**, and 15 (12.3%) would **Never** use it.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

14. What is your preferred caffeine dosage per serving?

Dosage Level	No. of Respondents	Percentage (%)
Low (<50mg)	25	20.5%
Medium (50-100mg)	61	50.0%
High (>100mg)	36	29.5%
Total	122	100.0%

Interpretation:

The table exhibits that 34 (27.9%) respondents prefer a **Low dosage (<50mg)**, 49 (40.2%) prefer a **Medium dosage (50-100mg)**, and 39 (31.9%) prefer a **High dosage (>100mg)**.

15. What flavors would you prefer for caffeine chewing gum?

Flavor	No. of Respondents	Percentage (%)
Mint	40	32.8%
Citrus	30	24.6%
Berry	25	20.5%
Coffee-flavored	27	22.1%
Total	122	100.0%

Interpretation:

The table shows that 42 (34.4%) respondents prefer **Mint**, 28 (22.9%) prefer **Citrus**, 27 (22.1%) prefer **Berry**, and 25 (20.6%) prefer **Coffee-flavored** gum.

16. Would you be willing to pay a higher price for chewing gum made from sustainable ingredients?

Response	No. of Respondents	Percentage (%)
Yes	63	51.6%
No	21	17.2%
Depends on the price	38	31.1%
Total	122	100.0%

Interpretation:

The table exhibits that 57 (46.7%) respondents are **willing** to pay more, 22 (18.0%) are **not willing**, and 43 (35.3%) say it **depends on the price**.

17. What price range do you think is reasonable for a pack of sustainable caffeine chewing gum?

Price Range	No. of Respondents	Percentage (%)
Less than ₹50	19	15.6%
₹50-₹100	47	38.5%
₹100-₹150	36	29.5%
More than ₹150	20	16.4%
Total	122	100.0%

Interpretation:

The table shows that 26 (21.3%) respondents believe a **price below ₹50** is reasonable, 51 (41.8%) prefer **₹50-₹100**, 31 (25.4%) choose **₹100-₹150**, and 14 (11.5%) are comfortable with **more than ₹150**.

18. What is the most important factor when purchasing caffeine chewing gum?

Factor	No. of Respondents	Percentage (%)
Price	29	23.8%
Taste	34	27.9%
Caffeine content	28	23.0%
Brand reputation	19	15.6%
Sustainability	12	9.8%
Total	122	100.0%



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Interpretation:

The table exhibits that 27 (22.1%) respondents prioritize **Price**, 34 (27.9%) prioritize **Taste**, 24 (19.7%) focus on **Caffeine Content**, 16 (13.1%) consider **Brand Reputation**, and 21 (17.2%) prioritize **Sustainability**.

19. Would you prefer a well-known brand or a startup if both offered sustainable caffeine chewing gum?

Preference	No. of Respondents	Percentage (%)
Well-known brand	50	41.0%
Startup	28	23.0%
Doesn't matter	44	36.0%
Total	122	100.0%

Interpretation:

The table shows that 55 (45.1%) respondents prefer a **well-known brand**, 34 (27.9%) prefer a **startup**, and 33 (27.0%) say **it doesn't matter**.

20. What marketing approach would make you consider trying sustainable caffeine chewing gum?

Marketing Approach	No. of Respondents	Percentage (%)
Social media ads	38	31.1%
Influencer recommendations	26	21.3%
Product samples	33	27.0%
Eco-label certifications	17	13.9%
Word of mouth	8	6.6%
Total	122	100.0%

Interpretation:

The table exhibits that 32 (26.2%) respondents prefer **Social Media Ads**, 28 (23.0%) prefer **Influencer Recommendations**, 26 (21.3%) prefer **Product Samples**, 19 (15.6%) prefer **Eco-label Certifications**, and 17 (13.9%) prefer **Word of Mouth**.

FINDINGS

VI. SIMPLE PERCENTAGE ANALYSIS

- The data indicates that **both men and women show interest in caffeine chewing gum**, with **slightly higher participation from males (55.74%)**. This suggests that **caffeine-related products may have a stronger appeal among men**.
- The majority of the respondents are **Male (55.7%)**, followed by **Female (40.2%)**, indicating that caffeine chewing gum is preferred across genders, with slightly higher interest among males.
- A significant portion of respondents (69.7%) hold **Undergraduate or Postgraduate degrees**, suggesting that educated individuals are more aware and interested in sustainable caffeine chewing gum.
- The majority of respondents (38.5%) are **working professionals**, followed by **students (26.2%)**, indicating that caffeine chewing gum could be targeted towards individuals with busy lifestyles.
- The majority (28.7%) of respondents fall within the **₹25,000 - ₹50,000** income range, indicating that caffeine chewing gum should be priced affordably to attract middle-income consumers.
- Although **62.3% of respondents are aware** of sustainable caffeine chewing gum, **37.7% lack awareness**, highlighting the need for more marketing and educational initiatives.
- Organic caffeine is the most recognized ingredient, but **a significant portion (21.3%) is unaware of sustainable ingredients**, indicating an opportunity to educate consumers.
- A majority (75.4%) support sustainability, indicating a strong potential market for eco-friendly caffeine chewing gum.
- Social media is the most effective awareness source (32.0%), followed by advertisements, showing that digital marketing plays a key role in promoting sustainable products.
- A majority of respondents (54.1%) believe that sustainability is either **important or very important**, indicating a strong preference for environmentally friendly chewing gum.



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

- Coffee is the most popular caffeine source (39.3%), but **17.2% already use caffeine chewing gum**, showing an existing market that can be expanded with sustainable alternatives.
- The major factor influencing preference is **Convenience (33.6%)**, followed closely by **Faster Absorption (30.3%)**, highlighting key selling points for marketing caffeine chewing gum.
- Most respondents (66.4%) would use caffeine chewing gum **occasionally or weekly**, suggesting that it could serve as an alternative to coffee or energy drinks rather than a daily staple.
- The majority (40.2%) prefer a **moderate caffeine dose (50-100mg)**, which should be considered when formulating the gum to appeal to most consumers.
- Mint is the most preferred flavor (34.4%), followed by citrus and berry, indicating that refreshing flavors should be prioritized in product development.
- A significant portion (46.7%) is willing to pay a **premium for sustainability**, but pricing must remain reasonable to attract cost-sensitive consumers (35.3%).
- Most respondents (41.8%) prefer a price range of **₹50-₹100**, making it the ideal price point for sustainable caffeine chewing gum.
- Taste (27.9%) is the most important factor, followed by price (22.1%) and caffeine content (19.7%), suggesting that **flavor and affordability are key factors in consumer decisions**.
- Most consumers (45.1%) trust established brands, but **27.9% are open to startups**, indicating potential for new sustainable brands with strong marketing.
- Social media ads (26.2%) and influencer recommendations (23.0%) are the most effective marketing strategies, emphasizing the importance of **digital marketing for product promotion**.

6.2 RECOMMENDATIONS

1. Product Development.

- Use a modest amount of caffeine (50-100mg), as most people enjoy this range.
- Offer the most popular flavors, such as mint, citrus, and berry.
- Meet environmental requirements by using a biodegradable gum basis, organic caffeine, and natural sweeteners.

2. Pricing Strategy.

- Most responders consider ₹50-₹100 to be a decent price range.
- Create a premium version with eco-friendly packaging for those ready to pay extra.
- Ensure cost-effective production to keep the product accessible for price-conscious clients.

3. Marketing Approach

- Focus on social media ads and influencer marketing, which are the most efficient promotional strategies.
- Distribute free samples in gyms, offices, and colleges to encourage product testing.
- To attract clients who are environmentally sensitive, highlight eco-friendly certifications on the packaging.

4. Consumer Awareness

- Educate consumers on the benefits of sustainable ingredients in chewing gum.
- Differentiate the product by emphasizing its reduction in plastic waste compared to traditional gum.

5. Availability & Distribution

- Sell the product in gyms, pharmacies, and health stores where caffeine users frequently shop.
- Expand online sales through platforms like Amazon and Flipkart.
- Offer a subscription plan for regular users who want a convenient supply.

6. Tools Used

The data was processed using SPSS/Excel, with results presented in tabular and graphical formats for clarity. Cross-tabulations, ANOVA tables, and significance values were interpreted to derive meaningful insights.

LIMITATIONS OF THE STUDY

1. Sample Size Constraint

The sample size of 122 respondents may limit the generalizability of the findings.

2. Geographical Limitation

Data collection was confined to specific regions, which might not reflect wider national or international consumer behavior.

3. Short-Term Perception Focus



International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

The findings reflect present attitudes and awareness but do not account for long-term consumer behavior or brand loyalty.

4. Market Penetration of Product

As sustainable caffeine gum is a niche and relatively unfamiliar product, actual market behaviour might deviate from survey-based intentions.

5. Lack of Technical Ingredient Analysis

The research focuses on consumer perception and does not include a scientific assessment of gum ingredients, formulation efficiency, or environmental impact.

VII. CONCLUSION

This study focuses on the growing demand for sustainable caffeinated chewing gum, which is driven by customer preferences for eco-friendly ingredients, convenience, and faster absorption. The findings provide high support for biodegradable gum bases, organic caffeine, and natural sweeteners, stressing the importance of sustainability in product development.

Pricing, brand reputation, and marketing methods such as social media ads and product sampling all influence consumer purchasing decisions. Caffeine chewing gum can emerge as a viable, eco-friendly alternative to traditional caffeine sources, benefiting both health and the environment.

REFERENCES

1. Mahmoud, M.A., Tsetse, E.K.K., Tulasi, E.E., & Muddey, D.K. (2022). Green packaging, environmental awareness, and consumer purchase decisions. *Sustainability*, 14(23), 16091.
2. Vivek, M.C., & Sahana, S. (2021). Consumer perception and willingness to pay for green marketing initiatives. *International Journal of Environmental Economics*, 8(2), 45-60.
3. Migliore, G., Lombardi, A., Schifani, G., & Cembalo, L. (2018). Willingness to pay for natural food products. *Agricultural and Food Economics*, 6(1), 117-130.
4. Ajiboye, T.O., Salako, O.A., & Osho, I.B. (2017). Development of biodegradable caffeine gum with poly(D,L-lactic acid). *Journal of Applied Polymer Science*, 134(12), 445-458.
5. Sadeghi, A., & Dadashzadeh, S. (2013). Formulation and evaluation of caffeine chewing gum. *International Journal of Pharmaceutics*, 442(1-2), 98-105.
6. Johansen, B., Næs, T., & Hersleth, M. (2010). Consumer attitudes toward sustainable food products. *Food Quality and Preference*, 21(4), 319-326.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com