

Manuscript Title:

Integrating Double Diamond Model and Material Driven Design to Enhance the Sensory Value of Agricultural Waste Materials: A Luffa Sponge Case Study

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Questionnaire on Product Design Research for Improving the Sensory Value of Luffa Sponge Material

Hello! We are conducting a research on the product design of luffa sponge, a natural material. This questionnaire aims to collect your basic perceptions of this material. Luffa sponge (also known as loofah) refers to the reticulated structure remaining after removing the flesh from fully mature luffa fruits. The questionnaire consists of 19 questions and will take about 3 minutes to complete. All collected data will be used for academic research only. Thank you for your support!

Part 1 Demographic Information

1. What is your age?

- A. Under 18
- B. 18-25
- C. 26-35
- D. 36-45
- E. 46-55
- F. Over 55

2. What is your gender?

- A. Male
- B. Female

3. What is your occupation?

- A. Student
- B. Teacher
- C. Medical and health worker
- D. Enterprise employee
- E. Civil servant
- F. Freelancer
- G. Retiree
- H. Others (Please specify)

4. Do you work or study in design, art or related fields/majors?

- A. Yes (Please specify)
- B. No

5. Where do you reside?

- A. First-tier city
- B. Second-tier city
- C. Third-tier city
- D. County seat
- E. Township
- F. Rural area

Part 2 Visual Perception

A 5-point Likert scale is adopted in this questionnaire (1 = Strongly disagree/Minimal impact, 2 = Disagree/Slight impact, 3 = Neutral/Moderate impact, 4 = Agree/Great impact, 5 = Strongly agree/Extreme impact). Please select the option that best aligns with your feelings according to the questions.

Section 1 Color Perception



5. When you first see a luffa sponge, which of the following descriptions best matches its color?

- A. Off-white
- B. Pale yellow
- C. Khaki
- D. Others (Please specify)

6. Do you think the color of luffa sponge looks natural?

- A. Very natural
- B. Relatively natural
- C. Neutral
- D. Not very natural
- E. Extremely unnatural

7. What kind of feelings does this color evoke in you? (Multiple choices allowed)

- A. Fresh
- B. Primitive and simple
- C. Stale
- D. Warm
- E. No special feeling
- F. Others (Please specify)

Section 2 Shape and Structure Cognition

8. How would you describe the shape of a luffa sponge? (Multiple choices allowed)

- A. Long strip
- B. Cylindrical
- C. Irregular shape
- D. Reticulated
- E. Others (Please specify)

9. Do you think the shape and structure of luffa sponge are unique?

- A. Extremely unique, rarely seen
- B. Relatively unique, with certain characteristics
- C. Neutral, similar structures are common
- D. Not unique, very ordinary

10. What does the shape and structure of luffa sponge remind you of? (Multiple choices allowed)

- A. Fishing net
- B. Honeycomb
- C. Sponge
- D. Plant veins
- E. Others (Please specify)

Section 3 Texture and Tactile Sensation

11. How would you describe the texture of luffa sponge?

- A. Coarse
- B. Delicate
- C. Have not touched it, no idea (Skip this entire section if selected)

12. Do you like the tactile sensation of this texture?

- A. Like it very much
- B. Like it relatively
- C. Neutral
- D. Do not like it very much
- E. Dislike it extremely

13. How would you rate the hardness or softness of the luffa sponge surface?

- A. Extremely hard
- B. Slightly hard
- C. Moderate hardness and softness
- D. Slightly soft
- E. Extremely soft

Part 4 Olfactory Impression

Section 1 Odor Perception

14. Can you smell the odor of luffa sponge?

- A. Yes
- B. No (Skip to Question 17 if selected)
- C. Have not smelled it, no idea (Skip this entire section if selected)

15. If yes, how would you describe the odor of luffa sponge? (Multiple choices allowed)

- A. Faint plant fragrance
- B. Hay-like odor
- C. Slight earthy smell
- D. No obvious special odor, just the smell of ordinary dried plants
- E. Others (Please specify)

16. Do you like the odor of luffa sponge? (No need to answer this question if you selected "No" in Question 15)

- A. Like it very much
- B. Like it relatively
- C. Neutral
- D. Do not like it very much
- E. Dislike it extremely

17. How would you rate the intensity of the luffa sponge's odor?

- A. Extremely faint, almost undetectable
- B. Relatively faint, need to smell closely
- C. Moderate, clearly detectable at a normal distance
- D. Relatively strong, easily detectable
- E. Extremely strong, even a bit pungent

Part 5 Comprehensive Sensory Perception and Association

18. What scenes come to your mind first when you see or touch a luffa sponge? (Multiple choices allowed)

- A. Rural countryside
- B. Kitchen
- C. Bedroom
- D. Bathroom
- E. Nothing in particular
- F. Others (Please specify)

19. In which fields do you think luffa sponge is suitable for application? (Multiple choices allowed)

- A. Household cleaning products (e.g., dishcloths, glass cleaning tools, etc.)
- B. Bath products (e.g., bath balls, bath scrubbers, etc.)
- C. Horticulture (e.g., soil loosening materials, biodegradable flowerpots, plant climbing trellises, etc.)
- D. Handicraft making
- E. Other ideas (Please specify)

Questionnaire on Product Design Research for Enhancing the Sensory Value of Luffa Sponge Material

Hello! We are conducting a research on the product design of luffa sponge—a natural material which is also known as loofah, referring to the reticulated structure remaining after the flesh is removed from fully mature luffa fruits. This questionnaire aims to collect your basic perceptual impressions of this material. It consists of 19 questions and will take approximately 3 minutes to complete. All collected data will be used for academic research only. Thank you for your support! [Single Choice]

1. What is your age? [Single Choice]

Options	Subtotal	Proportion
A. Under 18	8	9.2%
B. 18-25 years old	66	75.86%
C. 26-35 years old	8	9.2%
D. 36-45 years old	2	2.3%
E. 46-55 years old	0	0%
F. Over 55 years old	2	2.3%
Valid responses for this question	87	

2. What is your gender? [Single Choice]

Options	Subtotal	Proportion
A. Male	43	49.43%
B. Female	44	50.57%
Valid responses for this question	87	

3. What is your occupation? [Single Choice]

Options	Subtotal	Proportion
A. Student	62	71.26%
B. Teacher	2	2.3%
C. Medical and health worker	1	1.15%
D. Enterprise employee	10	11.49%
E. Civil servant	2	2.3%
F. Freelancer	8	9.2%
G. Retiree	1	1.15%
H. Others (Please specify)	1	1.15%
Valid responses for this question	87	

4. Do you work or study in design, art or related fields/majors? [Single Choice]

Options	Subtotal	Proportion
A. Yes (Please specify)	27	31.03%
B. No	60	68.97%
Valid responses for this question	87	

5. Where do you reside? [Single Choice]

Options	Subtotal	Proportion
A. First-tier city	24	27.59%
B. Second-tier city	33	37.93%
C. Third-tier city	13	14.94%
D. County seat	5	5.75%
E. Township	9	10.34%
F. Rural area	3	3.45%
Valid responses for this question	87	

6. When you first see a luffa sponge, which description best matches its color? [Single Choice]



Options	Subtotal	Proportion
A.Off-white	27	31.03%
B.Pale yellow	42	48.28%
C.Khaki	14	16.09%
D.Others (Please specify)	4	4.6%
Valid responses for this question	87	

7. Do you think the color of the luffa sponge appears natural? [Single Choice]

Options	Subtotal	Proportion
A. Very natural	38	43.68%
B. Relatively natural	43	49.43%
C. Neutral	3	3.45%
D. Not very natural	3	3.45%
E. Extremely unnatural	0	0%
Valid responses for this question	87	

8. What kind of feelings does this color evoke in you? [Multiple Choice]

Options	Subtotal	Proportion
A. Fresh	15	17.24%
B. Primitive and simple	60	68.97%
C. Stale	39	44.83%
D. Warm	34	39.08%
E. No special feeling	5	5.75%
F. Others (Please specify)	2	2.3%
Valid responses for this question	87	

9. How would you describe the shape of the luffa sponge? [Multiple Choice]

Options	Subtotal	Proportion
A. Long strip	41	47.13%
B. Cylindrical	42	48.28%
C. Irregular shape	19	21.84%
D. Reticulated	51	58.62%
E. Others (Please specify)	2	2.3%
Valid responses for this question	87	

10. Do you think the shape and structure of the luffa sponge are unique? [Single Choice]

Options	Subtotal	Proportion
A.Extremely unique, rarely seen	11	12.64%
B.Relatively unique, with distinctive features	63	72.41%
C.Neutral, similar structures are common	9	10.34%
D.Not unique, very ordinary	4	4.6%

Valid responses for this question	87	
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11. What does the shape and structure of the luffa sponge remind you of? [Multiple Choice]

Options	Subtotal	Proportion
A.Fishing net	33	37.93%
B.Honeycomb	44	50.57%
C.Sponge	54	62.07%
D.Plant veins	39	44.83%
E.Others (Please specify)	1	1.15%
Valid responses for this question	87	

12. How would you describe the texture of the luffa sponge? [Single Choice]

Options	Subtotal	Proportion
A.Coarse	59	67.82%
B.Delicate	14	16.09%
C.Have not touched it, no idea(Have not touched it, no idea)	14	16.09%
Valid responses for this question	87	

13. Do you like the tactile sensation of this texture? [Single Choice]

Options	Subtotal	Proportion
A.Like it very much	7	9.59%
B.Like it relatively	23	31.51%
C.Neutral	40	54.79%
D.Do not like it very much	3	4.11%
E.Dislike it extremely	0	0%
Valid responses for this question	73	

14. How would you evaluate the hardness or softness of the luffa sponge's surface? [Single Choice]

Options	Subtotal	Proportion
A.Extremely hard	2	2.74%
B.Slightly hard	32	43.84%
C.Moderate hardness and softness	31	42.47%
D.Slightly soft	8	10.96%
E.Extremely soft	0	0%
Valid responses for this question	73	

15. Can you perceive the odor of the luffa sponge? [Single Choice]

Options	Subtotal	Proportion
A. Yes	37	42.53%
B.No(Skip to Question 18 if selected)	30	34.48%
C.Have not smelled it, no idea(Skip this entire section if selected)	20	22.99%
Valid responses for this question	87	

16. If yes, how would you describe the odor of the luffa sponge? [Multiple Choice]

Options	Subtotal	Proportion
A.Faint plant fragrance	27	46.55%
B.Hay-like odor	29	50%
C.Slight earthy smel	9	15.52%
D.No obvious special odor, just the smell of ordinary dried plants	10	17.24%
E.Others (Please specify)	0	0%
Valid responses for this question	58	

17. Do you like the odor of the luffa sponge? (No need to answer if you selected "No" in Question 15) [Single Choice]

Options	Subtotal	Proportion
A.Like it very much	3	5.26%
B.Like it relatively	13	22.81%
C.Neutral	35	61.4%
D.Do not like it very much	4	7.02%
E.Dislike it extremely	2	3.51%
Valid responses for this question	57	

18. How would you evaluate the intensity of the luffa sponge's odor? [Single Choice]

Options	Subtotal	Proportion
A.Extremely faint, almost undetectable	8	13.79%
B.Relatively faint, need to smell closely	40	68.97%
C.Moderate, clearly detectable at a normal distance	10	17.24%
D.Relatively strong, easily detectable	0	0%
E.Extremely strong, even a bit pungent	0	0%

Valid responses for this question	58	
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19. What scenes come to your mind first when you see or touch a luffa sponge? [Multiple Choice]

Options	Subtotal	Proportion
A.Rural countryside	65	74.71%
B.Kitchen	55	63.22%
C.Bedroom	4	4.6%
D.Bathroom	11	12.64%
E.Nothing in particular	2	2.3%
F.Others (Please specify)	0	0%
Valid responses for this question	87	

20. In which fields do you think the luffa sponge is suitable for application? [Multiple Choice]

Options	Subtotal	Proportion
A.Household cleaning products (e.g., dishcloths, glass cleaning tools, etc.)	80	91.95%
B.Bath products (e.g., bath balls, bath scrubbers, etc.)	42	48.28%
C. Horticulture (e.g., soil loosening materials, biodegradable flowerpots, plant climbing trellises, etc.)	46	52.87%
D.Handicraft making	42	48.28%
F.Other ideas (Please specify)	0	0%
Valid responses for this question	87	

Questionnaire on Product Design Research for Enhancing the Sensory Value of Luffa Sponge Material

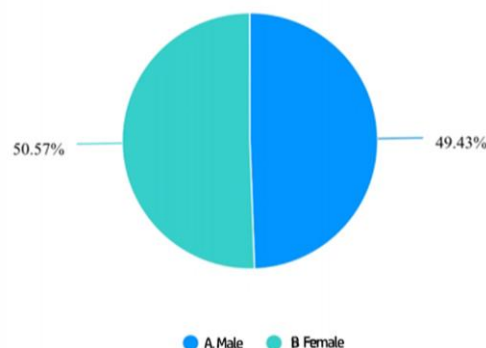
*This report was generated on November 30, 2025, at 16:21. A total of 87 valid questionnaires were collected from the online survey platform Wenjuanxing. AI-generated content carries potential risks and is for reference only.

Preface

To enhance the sensory value of luffa sponge, a natural material, and optimize its product design, this study conducted a questionnaire survey on the sensory characteristics (e.g., color, shape, texture, odor) and application scenarios of luffa sponge, collecting 87 valid responses in total. The survey covered respondents' basic sensory perceptions of luffa sponge (such as color naturalness, shape uniqueness, texture tactile sensation, odor preference) as well as associated scenarios and potential application fields. It aims to provide data support for the optimization of product design using luffa sponge material.

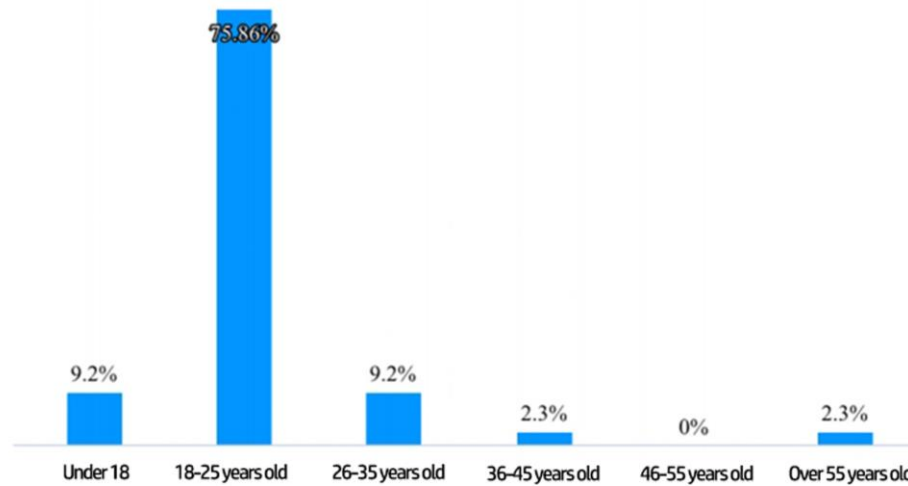
1. Respondents' age distribution is concentrated in the 18-25 age group

In terms of age distribution, respondents aged 18-25 account for a staggering 75.86%, the highest proportion among all age groups; followed by those under 18 and 26-35, both accounting for 9.2%; respondents aged 36-45 and over 55 each make up only 2.3%, and there are no respondents aged 46-55. The overall distribution is dominated by young groups, indicating a significant younger tendency in the age structure of the current sample. This may be related to the



attention of luffa sponge products among young people or the reach of the research channels. It is recommended that subsequent research appropriately expand the age coverage and increase sample collection from groups aged 36 and

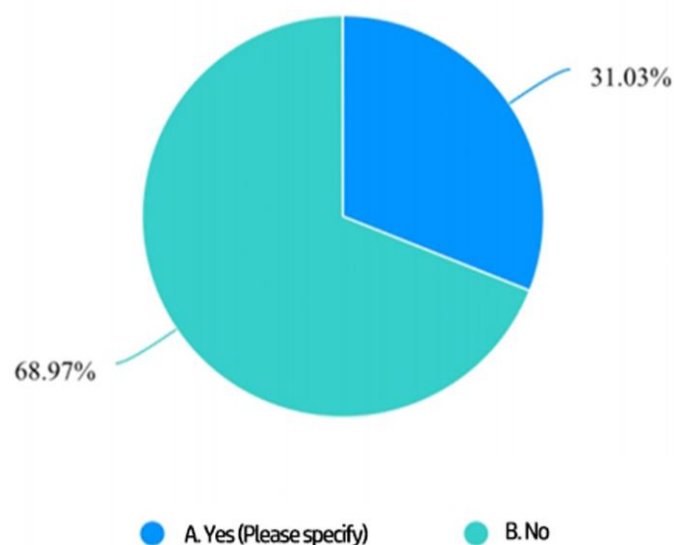
above, so as to more comprehensively understand the perceptions and demands of different age groups for luffa sponge materials and products.



*This conclusion is derived from Q1: Hello! We are conducting a research on the product design of luffa sponge, a natural material (also known as loofah: the reticulated structure remaining after removing the flesh from fully mature luffa fruits). This questionnaire aims to collect your basic perceptions of this material. It consists of 19 questions and will take approximately 3 minutes to complete. All data collected will be used for academic research only. Thank you for your support!

2. Gender distribution is nearly balanced

Males account for 49.43% and females 50.57%, with a small difference in proportion. The sample is evenly distributed in terms of gender, which can well

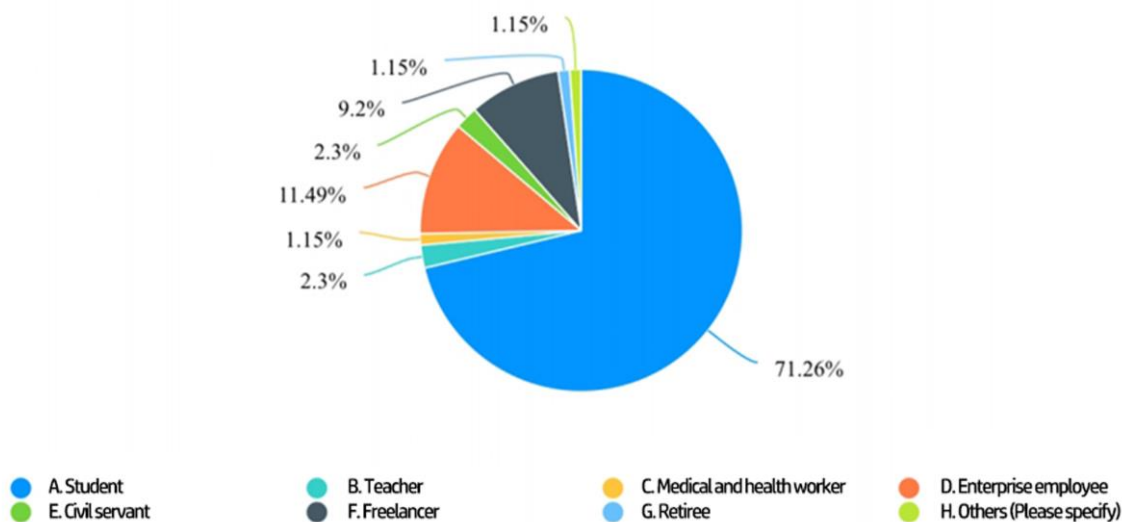


represent the group characteristics of different genders.

*This conclusion is derived from Q2: What is your gender?

3.Students are the dominant occupational group, accounting for over 70%

Among all respondents, the student group accounts for 71.26%, an absolute majority; followed by enterprise employees and freelancers, accounting for 11.49% and 9.2% respectively; teachers and civil servants each make up 2.3%, and medical and health workers, retirees and other occupations account for only 1.15%. Overall, the occupational distribution is highly concentrated, with the student group as the main component. It is recommended that subsequent research appropriately expand sample sources and increase the proportion of other occupational groups



to improve the universality of the research results.

*This conclusion is derived from Q3: What is your occupation?

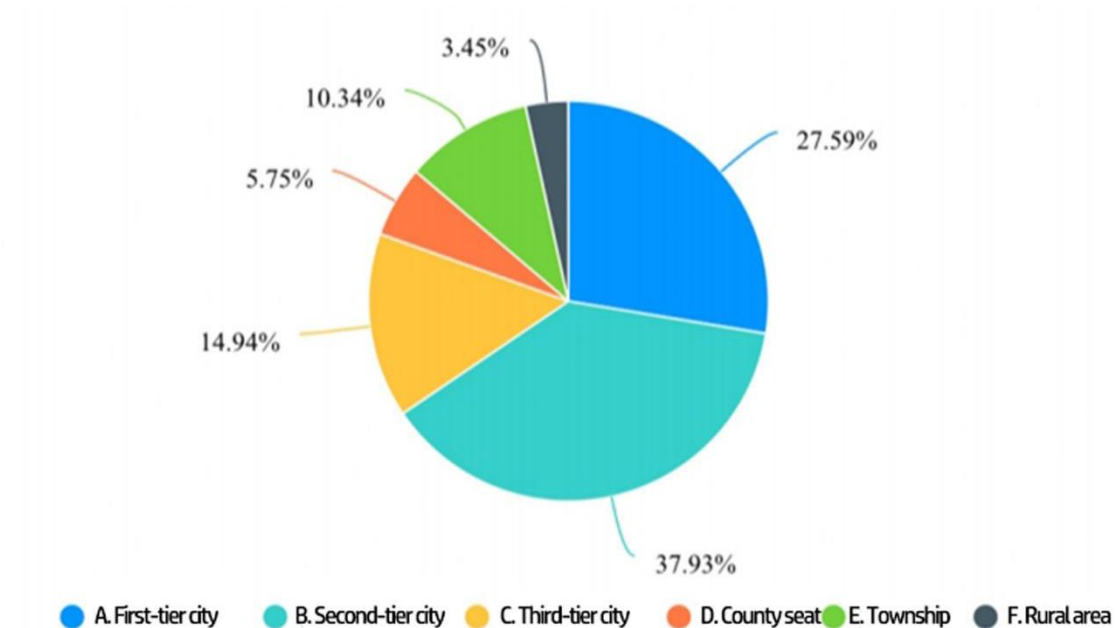
4. Nearly 70% of the respondents are not engaged in or studying design, art or related fields/majors

Among the survey participants, 68.97% have no engagement in or academic background of design, art or related fields/majors, exceeding two-thirds of the total; while 31.03% are engaged in or studying such fields/majors, less than one-third of the total. This indicates that the research group has a relatively low direct correlation with design and art-related fields. From the perspective of the representativeness of the research sample, if the research aims at design and art practitioners or learners, the current sample may have biases. It is recommended that subsequent research appropriately increase the sampling proportion of people in this field to improve the fit between the sample and the research objectives

*This conclusion is derived from Q4: Do you work or study in design, art or related fields/majors?

5.Respondents are mainly from second-tier cities, followed by first-tier cities, with a small proportion from lower-tier cities and rural areas

In terms of residential distribution, second-tier cities account for the highest proportion (37.93%), close to 40%; first-tier cities account for 27.59%, with the two totaling more than 60%. Third-tier cities make up 14.94%, while county seats, townships and rural areas account for 5.75%, 10.34% and 3.45% respectively. The overall proportion of lower-tier cities and rural areas is less than 20%. This shows that the current respondents are mainly concentrated in first and second-tier cities with a high level of economic development. In the future, appropriate efforts can



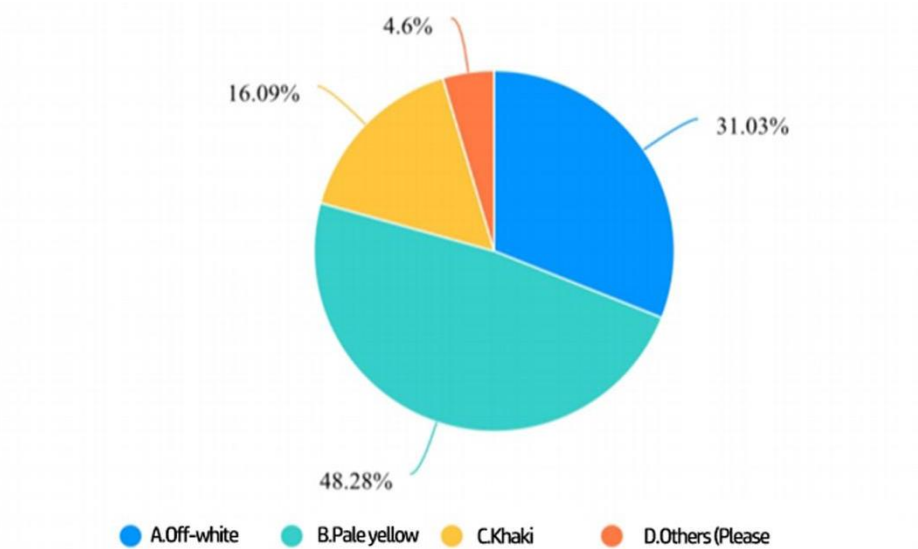
be made to increase sample coverage in lower-tier cities and rural areas to gain a more comprehensive understanding of the situation in different regions.

*This conclusion is derived from Q5: Where do you reside?

6.Pale yellow is the dominant color perception of luffa sponge at first sight

Among all respondents, 48.28% consider the color of luffa sponge to be close to pale yellow, exceeding the total proportion of those who perceive it as off-white (31.03%), khaki (16.09%) and other colors (4.6%), indicating that pale yellow is

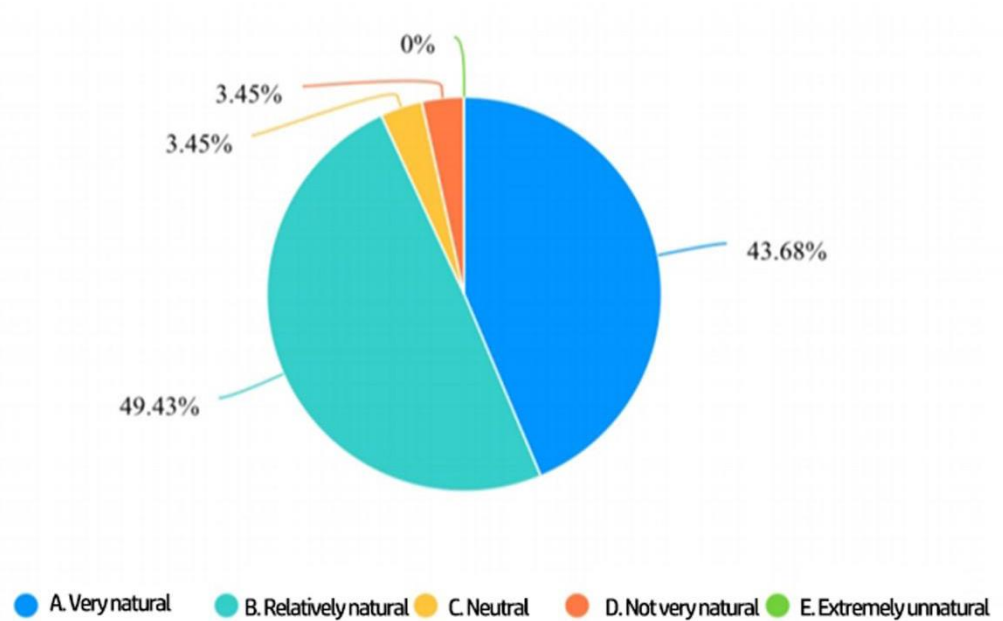
the most common color perception of luffa sponge. It is suggested that in the appearance design or promotion of luffa sponge products, the mainstream cognitive feature of pale yellow can be highlighted to conform to the public's general impression of the product's color



*This conclusion is derived from Q6: When you first see a luffa sponge, which description best matches its color?

7. The overall evaluation of the color naturalness of luffa sponge is positive

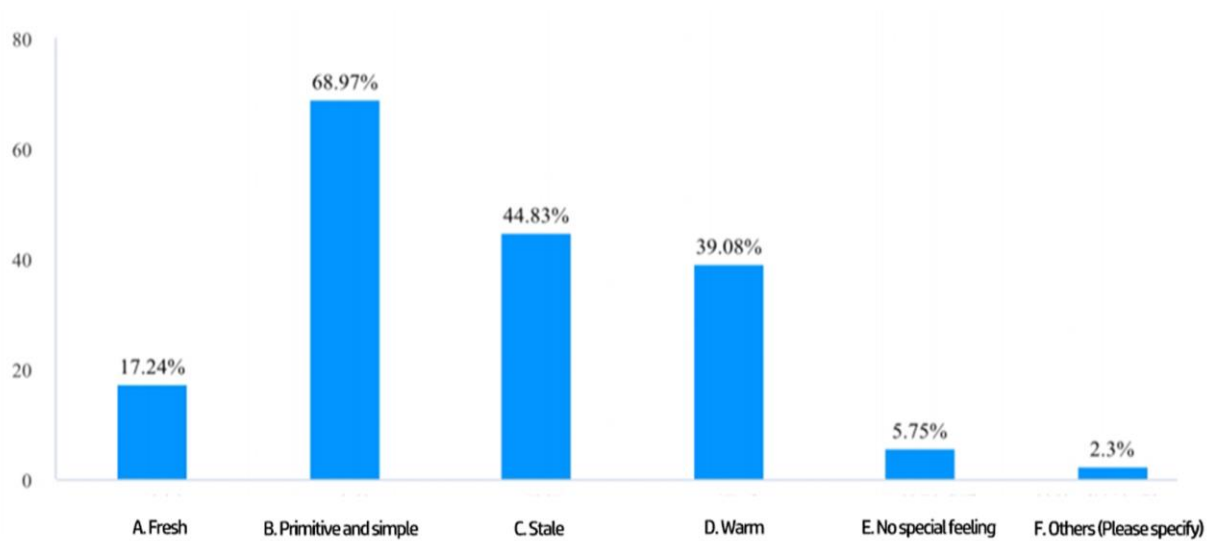
More than 90% of the respondents believe that the color of luffa sponge is natural, among which 43.68% think it is "very natural" and 49.43% "relatively natural"; the proportions of those who consider it "neutral" and "not very natural" are both 3.45%, and 0% think it is "extremely unnatural". It is recommended to maintain the current color presentation process, and investigate the specific reasons for the feedback from the very few respondents who think the color is not very natural to optimize details.



*This conclusion is derived from Q7: Do you think the color of the luffa sponge appears natural?

8. Primitive and simple is the most perceived feeling from the color, with extremely low proportions of no special feeling and other feelings

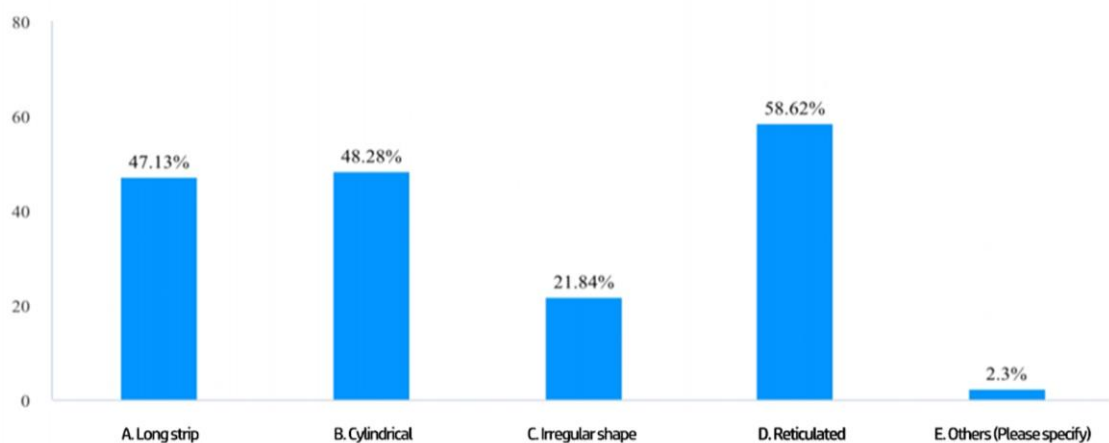
In terms of the proportion of various feelings, "primitive and simple" ranks first with 68.97%, significantly higher than other feelings; while "no special feeling" accounts for only 5.75% and "other feelings" as low as 2.3%. This indicates that most people have a clear and concentrated perception of the color, with primitive and simple being the main impression label. It is suggested that subsequent research can further explore the cultural connotations or emotional connection points behind this core feeling to better utilize this characteristic of the color.



*This conclusion is derived from Q8: What kind of feelings does this color evoke in you? (Multiple choices allowed)

9. Respondents' cognition of the shape of luffa sponge is mainly reticulated and cylindrical

In the description of the shape of luffa sponge, "reticulated" is the most selected with a proportion of 58.62%, followed by "cylindrical" at 48.28% and "long strip" at 47.13%. The proportions of the three are all relatively high and close, while "irregular shape" accounts for 21.84% and "other shapes" only 2.3%. This shows that most respondents believe that luffa sponge has a reticulated structure, and their cognition of its overall shape tends to be cylindrical or long strip, with relatively little cognition of irregular shapes and extremely rare descriptions of other special shapes. It is suggested that in product promotion or introduction,

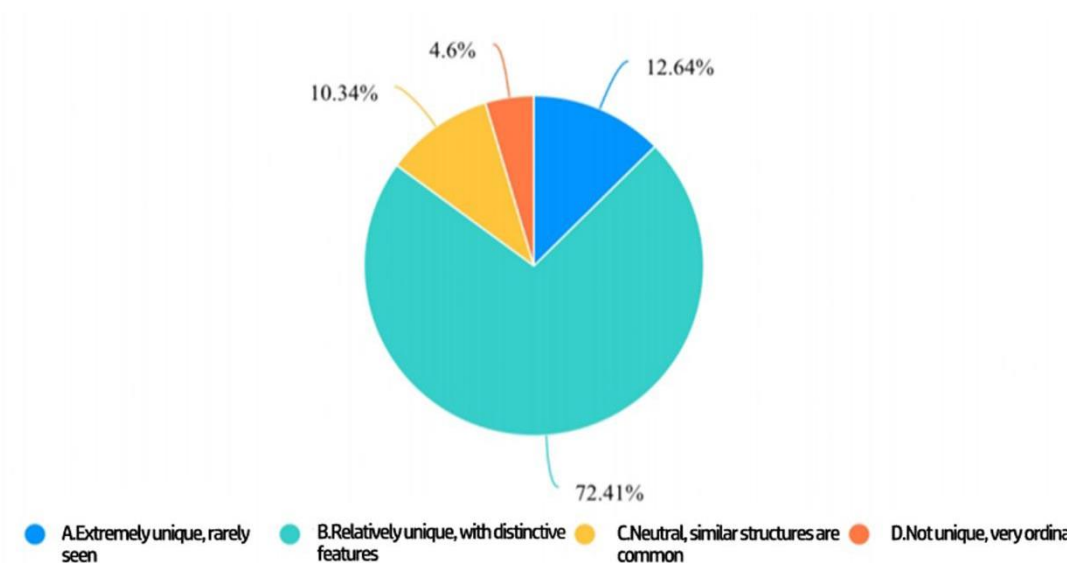


the reticulated characteristic and common cylindrical/long strip shapes of luffa sponge can be highlighted to conform to public cognition.

*This conclusion is derived from Q9: How would you describe the shape of the luffa sponge?
(Multiple choices allowed)

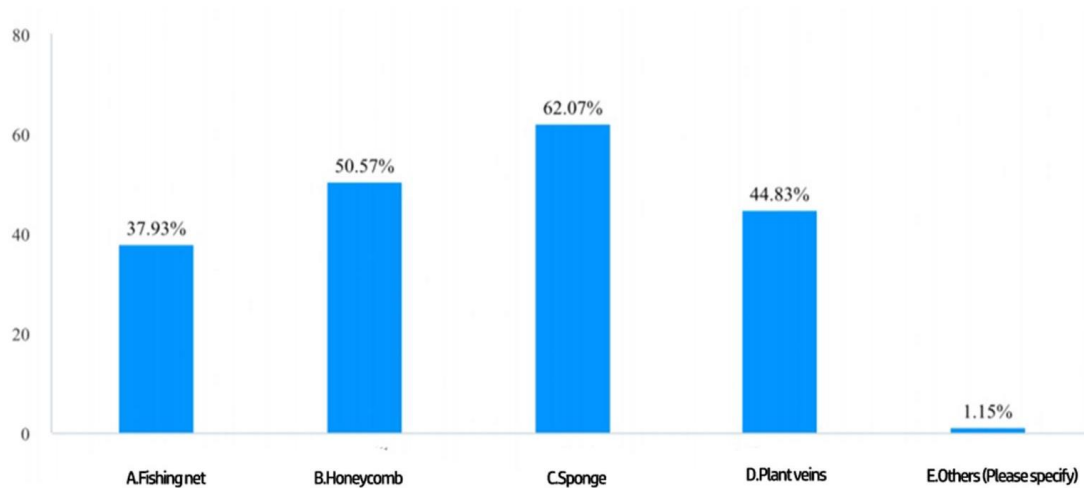
10. Most respondents believe that the shape and structure of luffa sponge are unique

The total proportion of respondents who choose "extremely unique, rarely seen" and "relatively unique, with distinctive features" exceeds 80%, indicating that the shape and structure of luffa sponge present a high degree of uniqueness in the cognition of respondents. In contrast, the total proportion of those who consider it "neutral, similar structures are common" and "not unique, very ordinary" is less than 15%, reflecting that a small number of people have a weak perception of its uniqueness. It is suggested that subsequent promotion can focus on the specific application scenarios of the unique structure of luffa sponge to further strengthen the public's cognition of its unique value



*This conclusion is derived from Q10: Do you think the shape and structure of the luffa sponge are unique?

11. There are obvious differences in respondents' associations with the shape and structure of luffa sponge

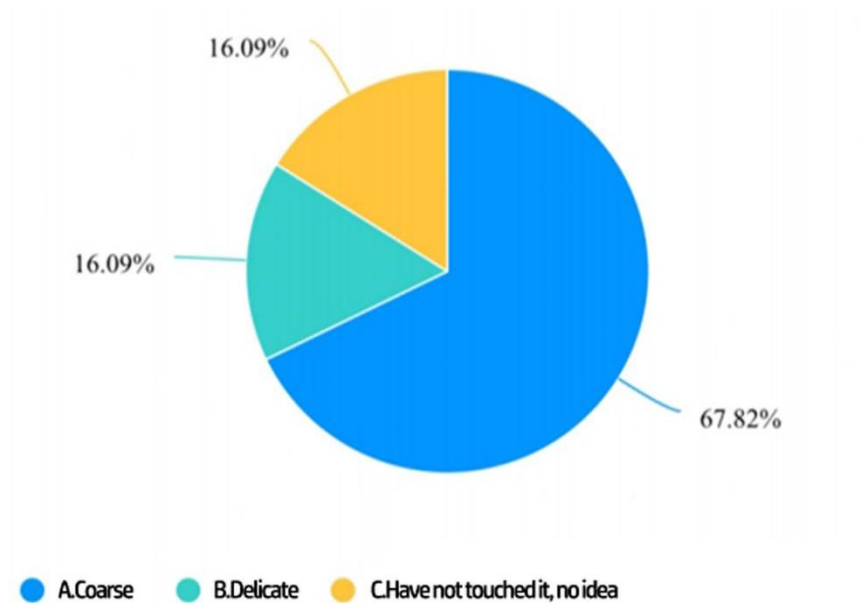


Data shows that "sponge" is the most selected with a proportion of 62.07%, indicating that most people think the structure of luffa sponge is quite similar to that of sponge; followed by "honeycomb" at 50.57%; "plant veins" and "fishing net" account for 44.83% and 37.93% respectively; while the proportion of choosing "other things" is extremely low at only 1.15%. Overall, sponge is the thing that respondents most easily associate with luffa sponge, which may be due to the similar porous and elastic structural characteristics of luffa sponge and sponge. In addition, honeycomb, plant veins and fishing net are also to a certain extent similar to the reticulated or vein-like structure of luffa sponge. It is suggested that in the subsequent promotion or design of related products, the similarity between luffa sponge and sponge can be highlighted to be more in line with public cognition.

*This conclusion is derived from Q11: What does the shape and structure of the luffa sponge remind you of? (Multiple choices allowed)

12. Most respondents consider the texture of luffa sponge to be coarse

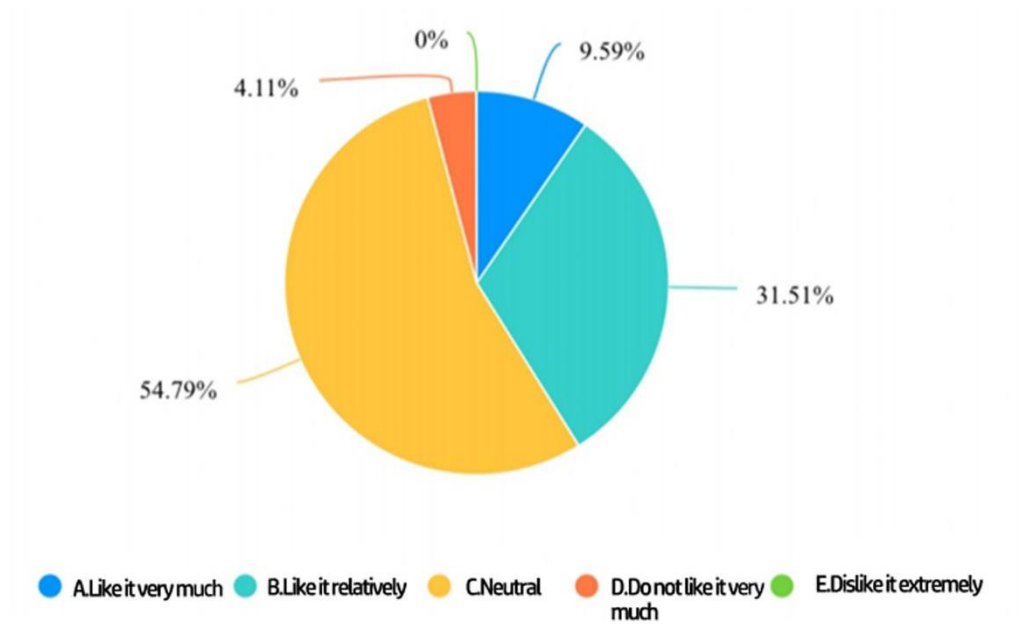
Among all respondents who provided feedback, more than two-thirds (67.82%) think the texture of luffa sponge is coarse, while 16.09% each consider it delicate and state that they have not touched it and have no idea, accounting for a relatively small proportion. This indicates that among people with a clear perception, coarse is the main impression of the texture of luffa sponge.



*This conclusion is derived from Q12: How would you describe the texture of the luffa sponge?

13. The dominant degree of liking for the tactile sensation of the texture is "neutral", followed by "relatively like"

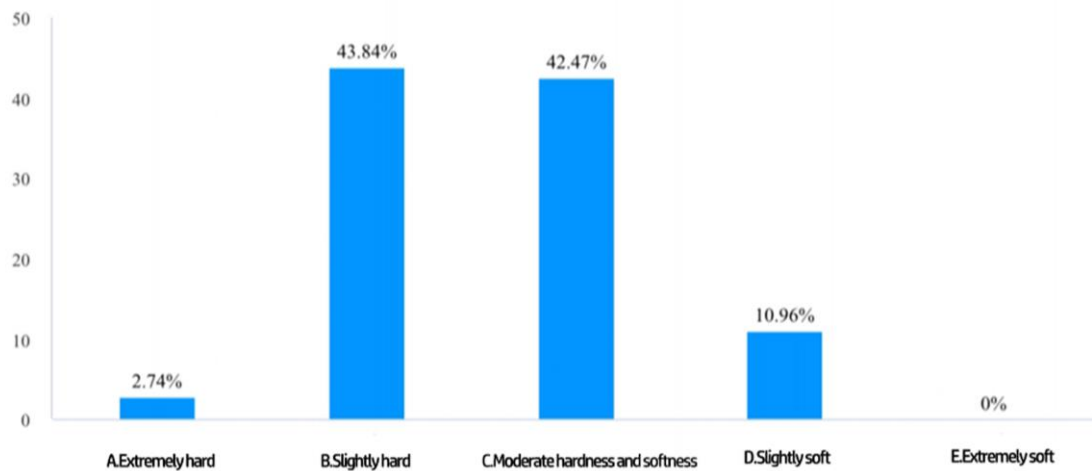
Data shows that "neutral" is the most selected with a proportion of 54.79%, indicating that more than half of the users have no particularly strong preference for the tactile sensation of the texture; "relatively like" accounts for 31.51%, with nearly one-third of users holding a positive attitude towards the tactile sensation; "like it very much" makes up 9.59%, while "do not like it very much" is only 4.11% and "dislike it extremely" 0%. Overall, users' acceptance of the tactile sensation of the texture is acceptable, but the preference degree is not high, with the neutral attitude accounting for the largest proportion. It is suggested that subsequent research can investigate the user group with a "neutral" attitude to understand the specific reasons why they consider the tactile sensation "neutral", such as whether there is room for improvement in softness, smoothness, etc., so as to enhance users' liking degree.



*This conclusion is derived from Q13: Do you like the tactile sensation of this texture?

14. The evaluation of the surface hardness of luffa sponge is mainly "slightly hard" and "moderate hardness and softness"

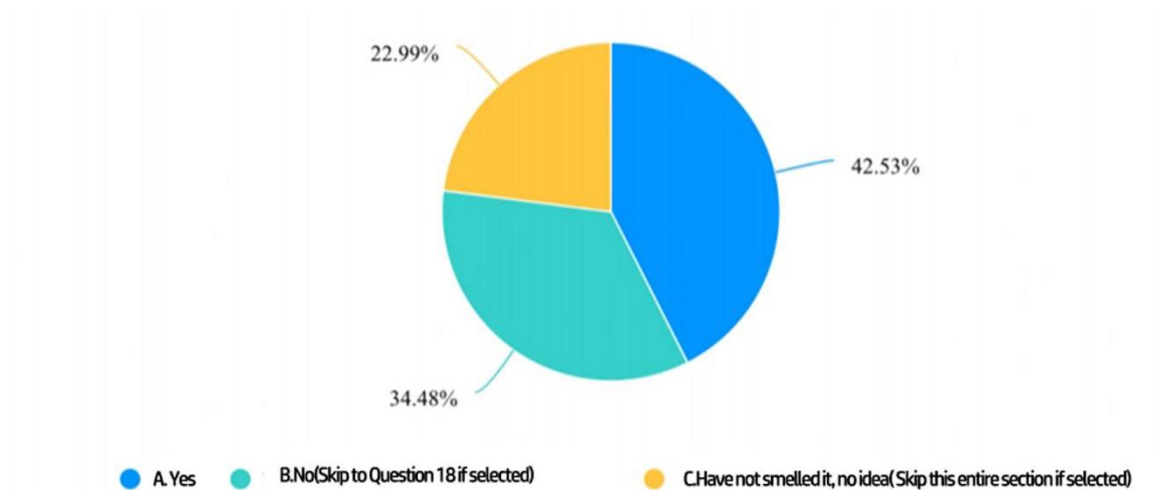
Overall, 43.84% of respondents choose "slightly hard" and 42.47% "moderate hardness and softness", with the two totaling as high as 86.31%. This shows that most users believe the hardness of luffa sponge is in the medium-hard or moderate range; while the proportions of "extremely hard", "slightly soft" and "extremely soft" are 2.74%, 10.96% and 0% respectively, accounting for a relatively low proportion, indicating that extreme hardness evaluations are rare. It is suggested that the processing technology of luffa sponge can be further optimized for the user group who prefer "moderate hardness and softness", and the hardness can be appropriately adjusted to improve the overall satisfaction.



*This conclusion is derived from Q14: How would you evaluate the hardness or softness of the luffa sponge's surface?

15 Nearly 40% of Respondents Can Perceive the Odor of Luffa Sponge

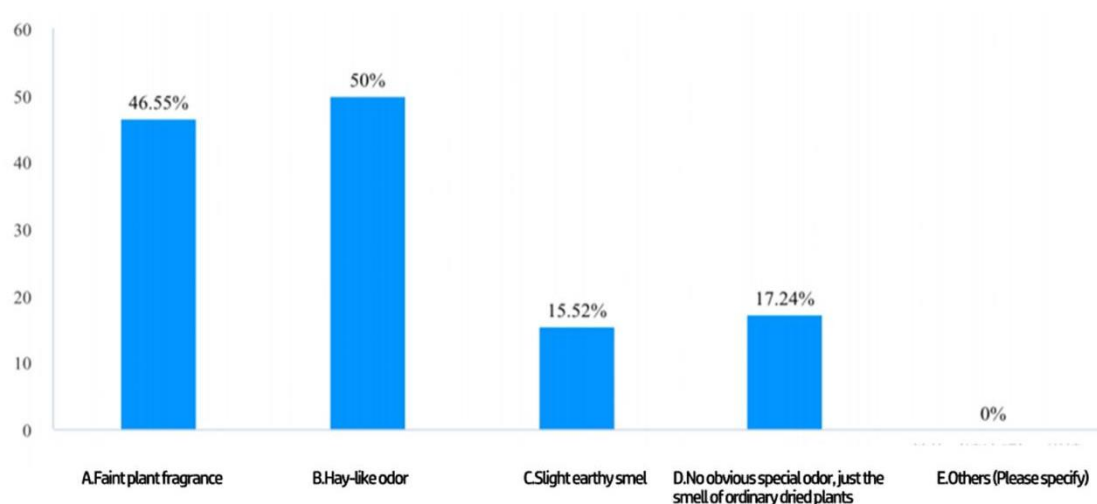
Among the survey participants, 42.53% reported being able to perceive the odor of luffa sponge, accounting for more than 40% of the total. This indicates that a considerable proportion of people have a clear perceptual awareness of the odor of luffa sponge.



*This conclusion is derived from Q15: Can you perceive the odor of the luffa sponge?

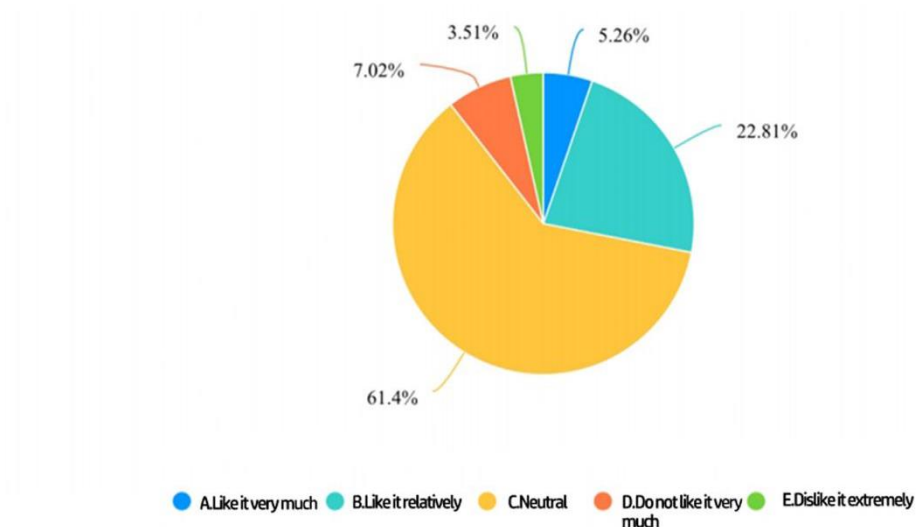
16 Hay-like Odor is the Most Dominant Description of Luffa Sponge's Odor, Followed by Faint Plant Fragrance

Among all respondents who can perceive the odor of luffa sponge, 50% described it as a hay-like odor, the highest proportion among all options; this was followed by a faint plant fragrance at 46.55%. These two descriptions are the primary olfactory perceptions of luffa sponge among respondents. In comparison, only 15.52% perceived a slight earthy smell and 17.24% stated there was no obvious special odor, merely the smell of ordinary dried plants, with relatively low proportions for these two options. No respondents selected the "Other" option, demonstrating that perceptual descriptions of luffa sponge's odor are highly concentrated in hay-like and plant fragrance notes. It is suggested that in product introductions or promotions, the natural odor characteristics of luffa sponge—its hay-like and faint plant fragrance—be highlighted to align with the perceptual experiences of the majority.



*This conclusion is derived from Q16: If yes, how would you describe the odor of the luffa sponge? (Multiple choices allowed)

17 A Neutral Attitude Towards Luffa Sponge's Odor is the Most Prevalent Among Respondents

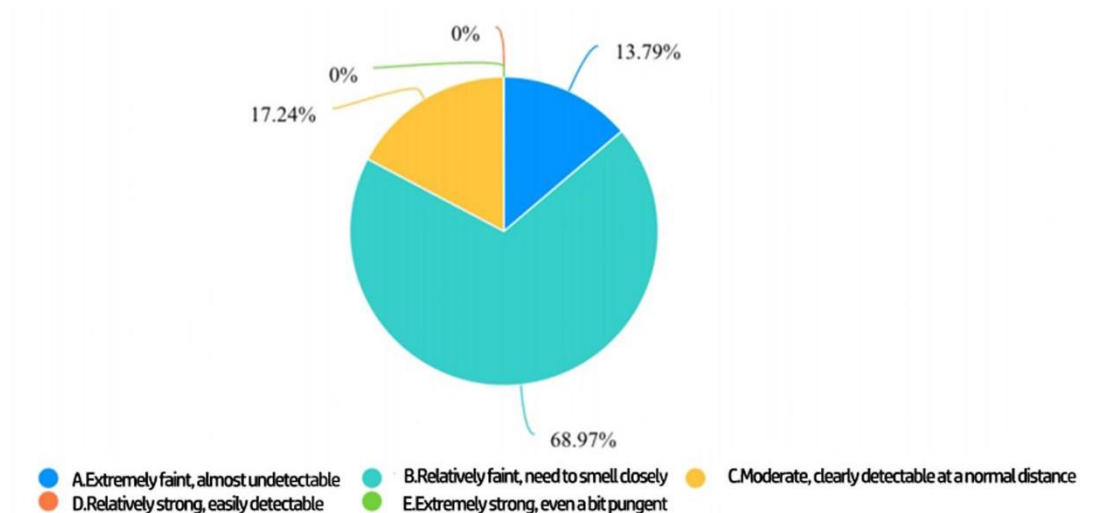


Among all respondents, 61.4% selected a neutral attitude towards luffa sponge's odor, a proportion significantly higher than that of other options. This indicates that more than half of the participants hold no distinct preference for or aversion to the odor. In contrast, the proportions of respondents who liked it very much and disliked it extremely were relatively low, at 5.26% and 3.51% respectively; 22.81% liked it relatively, and 7.02% did not like it very much. The overall distribution is characterized by a high proportion of neutral attitudes and low proportions at both extremes. It is suggested that subsequent research investigate the group with a neutral attitude to identify the specific reasons for their olfactory insensitivity, or consider optimizing the product's odor (e.g., adding natural spices) to enhance acceptance among this population.

*This conclusion is derived from Q17: Do you like the odor of the luffa sponge? (No need to answer if you selected "No" in Question 15)

18 The Odor Intensity of Luffa Sponge is Dominated by a Relatively Faint Perception

More than two-thirds of respondents (68.97%) perceived the odor of luffa sponge as relatively faint, requiring close sniffing to detect; this was followed by extremely faint, almost undetectable (13.79%) and moderate intensity, clearly detectable at a normal distance (17.24%). Notably, 0% of respondents described the odor as relatively strong or extremely strong. Overall, the odor intensity of luffa sponge is universally perceived as low, with no obvious pungent properties. It is suggested that the faint odor characteristic of luffa sponge be highlighted in

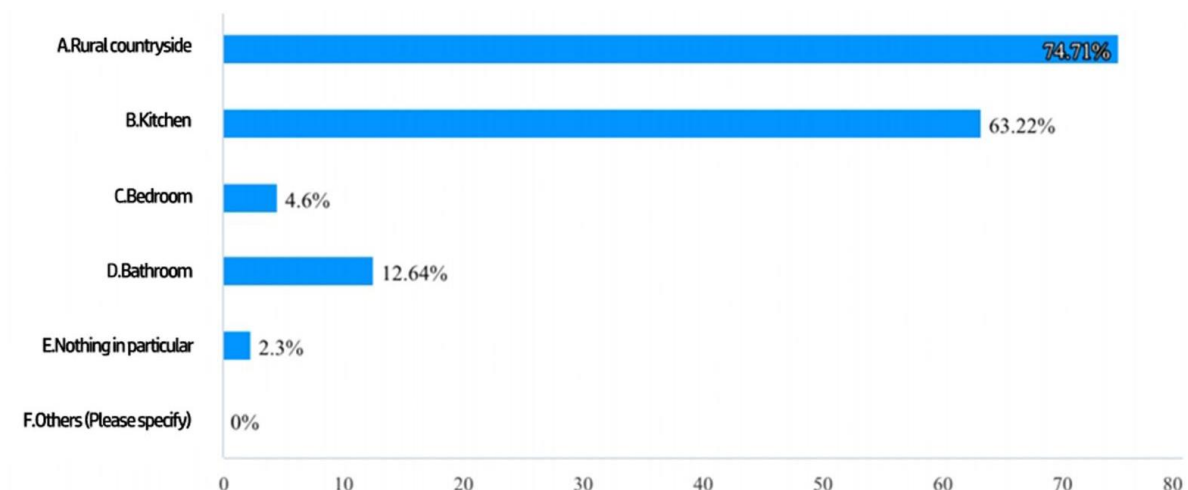


product promotions to attract consumers who are sensitive to strong smells.

*This conclusion is derived from Q18: How would you evaluate the intensity of the luffa sponge's odor?

19 Rural Countryside and Kitchen are the Primary Associative Scenes When Seeing or Touching Luffa Sponge

Data shows that 74.71% of respondents associated luffa sponge with the rural countryside and 63.22% with the kitchen, with these two scenes far outpacing

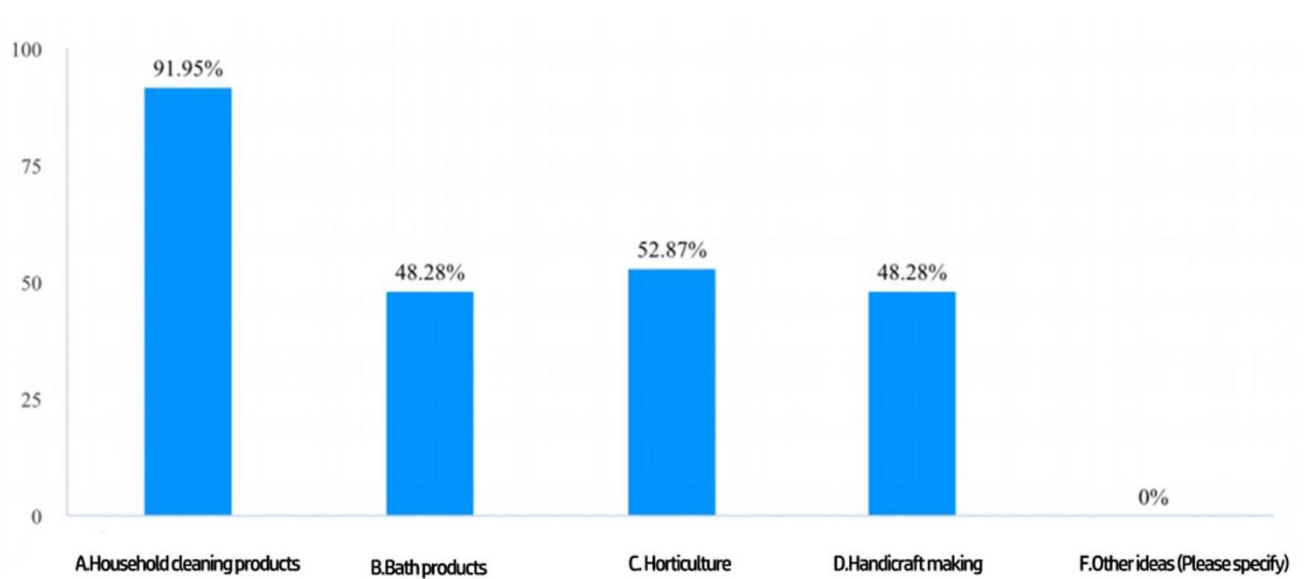


others in terms of association frequency. The proportions of associations with the bedroom (4.6%), bathroom (12.64%), no specific scene (2.3%), and other scenes (0%) were relatively low. This indicates that luffa sponge has an extremely high cognitive correlation with rural countryside and kitchen scenes among the public. It is suggested that in the promotion and design of luffa sponge-related products, its connection to the natural, simple rural lifestyle and its practical functions in the kitchen be emphasized to better align with consumers' common associative perceptions.

*This conclusion is derived from Q19: What scenes come to your mind first when you see or touch a luffa sponge? (Multiple choices allowed)

20 Household Cleaning Products are the Most Highly Recognized Application Field for Luffa Sponge

Among all optional application fields, 91.95% of respondents selected household cleaning products (e.g., dishcloths, glass cleaning tools), a proportion significantly higher than that of other fields, demonstrating widespread public recognition of luffa sponge's high applicability in this area. In contrast, the proportions of respondents selecting bath products (48.28%), horticulture (52.87%), and handicraft making (48.28%) were relatively close, all below 55%. No respondents selected "Other ideas", indicating that current public cognition of luffa sponge's application fields is mainly concentrated in the aforementioned areas, with household cleaning products as the absolute mainstream. It is suggested that priority be given to developing luffa sponge products for the high-end household cleaning market; meanwhile, targeted promotion and popularization efforts be undertaken to raise awareness of its applications in horticulture and handicraft making.



*This conclusion is derived from Q20: In which fields do you think the luffa sponge is suitable for application? (Multiple choices allowed)0

Conclusion

This survey reveals the key characteristics and improvement directions of luffa sponge material in terms of sensory value and product design potential. The core conclusions and insights are as follows:

Distinct Advantages in Natural Color, Yet Room for Deepening Emotional

Connection: Pale yellow is the most prevalent color perception of luffa sponge, and its sense of naturalness has been highly recognized by more than 90% of respondents—this constitutes the core advantage of luffa sponge as a natural material. The dominant emotional perception evoked by its color is primitive and simplicity (68.97%), while more positive and diverse emotional associations such as warmth and freshness account for relatively low proportions.

Recommendation: On the basis of retaining its natural color tone, explore the use of mild natural processing techniques (e.g., screening by ripeness, gentle bleaching or dyeing attempts) or design matching to guide more diverse, modern aesthetically consistent positive emotional associations beyond "primitive and simple", such as enhancing the sense of warmth or freshness.

Prominent Structural Uniqueness, Clear Morphological Cognition, and Vast

Space for Creative Transformation: The reticulated structure (58.62%) and

cylindrical/long strip morphology (48.28%/47.13%) are the main characteristics of luffa sponge, and more than 80% of respondents recognize the uniqueness of its shape and structure. In terms of associations, strong cognitive links exist with sponge (62.07%), honeycomb (50.57%), and plant veins (44.83%), suggesting great potential for the functional and aesthetic application of its structure. **Recommendation :** Fully utilize its unique natural reticulated structure and regular/near-regular morphology for structural design. For example, draw on the sponge association to develop more efficient cleaning or buffering products; combine the delicate precision of honeycombs to explore applications in decorative articles, lightweight structural components or cultural and creative products; leverage the natural aesthetics of plant veins to develop bionic design-inspired household or artistic installations.

Divergent Evaluations of Texture and Tactile Sensation, with Comfort and Functional Adaptation as the Key: Most respondents perceive luffa sponge's texture as coarse (67.82%), with a neutral attitude (54.79%) as the dominant response to tactile liking; evaluations of slightly hard (43.84%) and moderate hardness and softness (42.47%) coexist. **Recommendation:** Address the issues of coarseness and hardness by researching different processing techniques (e.g., sanding, softening treatment, compounding with other flexible materials) to improve tactile sensation, especially for products in direct contact with the skin (e.g., bath products). At the same time, recognize that coarseness is an advantage in specific application scenarios (e.g., heavy-duty cleaning), and determine whether texture adjustment is required based on the specific functional positioning of the product to achieve precise matching between tactile comfort and functional requirements.

Elegant and Natural Odor with Acceptable Popularity, Usable as a Secondary Selling Point: Nearly 40% of respondents can perceive the odor of luffa sponge, with the main perceptions being hay-like odor (50%) and faint plant fragrance (46.55%); the odor intensity is universally weak (68.97% described it as relatively faint), with an overall acceptable level of public acceptance. **Recommendation:** For functional products such as cleaning and horticultural supplies, its elegant natural odor can be used as a natural selling point highlighting no chemical additives. If odor experience enhancement is needed,

consider adding natural plant essential oils, while ensuring the preservation of its natural properties and avoiding the introduction of artificial fragrances.

Concentrated Cognition of Application Scenarios and Fields, Requiring Expansion and Upgrading: Respondents' primary associative scenes are highly concentrated in the rural countryside (74.71%) and kitchen (63.22%); in terms of application fields, household cleaning products (91.95%) are the absolute mainstream, with a certain degree of cognition for horticulture (52.87%), bath products (48.28%) and handicraft making (48.28%), though their proportions are not high. **Recommendation: Deepen the cleaning field:** On the basis of consolidating traditional advantages such as kitchen cleaning, develop high-end, multi-functional household cleaning product series through design innovation and material optimization.

Expand emerging fields: Leverage the rural countryside association to develop home decorations and cultural and creative products with natural aesthetics and pastoral styles; utilize its natural, biodegradable characteristics for innovation in horticulture (e.g., seedling pots, plant supports) and environmentally friendly packaging materials.

Enhance product added value: Break the single-function cognition, combine luffa sponge with other natural materials through design to develop composite products with both practical functions and aesthetic value, and raise its recognition and added value in the fields of handicrafts, home accessories and even fashion accessories.

Sample Structure Implication: The sample of this survey is dominated by young student groups, who may have a high degree of acceptance and exploratory desire for new materials and designs. Future research needs to further verify the applicability of the findings among populations with a broader distribution of age, occupation and region, with a particular focus on the needs of consumers over 36 years old and those in non-first and second-tier cities, to make product design more universal.

In summary, as a natural material, luffa sponge's core advantages lie in its natural properties and unique structure. To enhance its sensory value, efforts should **focus on the diversified guidance of color emotions, the creative transformation of its unique structure, and the targeted optimization of tactile sensation.** Additionally, it is necessary to **break the single cognition of luffa sponge as a cleaning product and expand its applications to broader, high-added-value fields,** thereby maximizing its sensory value and product market potential.