Variations and Trends in Rice Quality across Different Types of Approved Varieties in China, 1978–2022

Yuqing Lu 1, Ying Tang 1, Jiaen Zhang 1, Si Liu 1, Xiaoyue Liang 1, Meijuan Li 2,* and Ronghua Li 1,*

1 College of Natural Resources and Environment, South China Agricultural University, Guangzhou 510642, China; luzn360302@163.com (Y.L.); tangy@stu.scau.edu.cn (Y.T.); jeanzh@scau.edu.cn (J.Z.); liusi.scau.edu.cn@stu.scau.edu.cn (S.L.); liangxy56@stu.scau.edu.cn (X.L.)
2 Rice Research Institute, Guangdong Rice Engineering Laboratory, Key Laboratory of Genetics and Breeding of High-Quality Rice in Southern China (Co-Construction by Ministry and Province), Ministry of Agriculture and Rural Affairs, Guangdong Academy of Agricultural Sciences, Guangzhou 510640, China
* Correspondence: limeijuan@gdaas.cn (M.L.); lironghua@scau.edu.cn (R.L.)

Abstract: Rice is a staple food for nearly two-thirds of China’s population. As socio-economic development continues, there is a growing demand for high-quality rice. This study collected grain quality traits for 17,785 rice varieties approved throughout China, and categorized them into the following five types: indica inbred (II), indica hybrid (IH), japonica inbred (JI), japonica hybrid (JH), and indica-japonica hybrid (IJ). Comprehensive analyses were conducted to assess the differences and trends in rice quality across these varieties. We found that JI and JH excel in processing and cooking qualities, featuring higher brown rice and head milled rice rates, coupling with longer gel consistency. Inbred varieties display lower chalky rice rates than hybrids. Over several decades, head milled rice rates have notably increased across all types except for IJ. Transparency values has decreased in nearly all types except for IJ, with similar declines observed in chalky rice rates and chalkiness degree, suggesting an overall progress in appearance quality. In terms of cooking and taste attributes, amylose content has decreased in most varieties except for JI, and gel consistency has improved in indica varieties. Generally, the rice quality of varieties approved in China has shown a clear trend of improvement over the past 40 years. This study provides significant data support and theoretical backing for ongoing rice breeding efforts.

Keywords: inbred rice; hybrid rice; indica rice; japonica rice; processing quality; appearance quality; cooking and taste quality; nutritional quality

1. Introduction

Rice (Oryza sativa L.) is the principal food crop in China, with nearly two-thirds of the population relying on rice as their staple food [1]. The area sown with rice in China accounts for about 18% of the total sown area of agricultural crops, approximately 29.61 million hectares. From 2000 to 2021, the annual average production of rice was about 194.09 million tons, which represents approximately 35% of the total national grain production [2]. The secure production and stable yield growth of rice are crucial for ensuring national food security. Traditionally, the main goal of rice breeding in China has been to enhance yield [3]. However, while high-yielding rice varieties generally exhibit poorer quality, those of high-quality often have lower yields. As socio-economic development continues and living standards improve, there is an increasing domestic demand for high-quality rice. Therefore, resolving the contradiction between high-yield and high-quality presents a significant challenge for rice breeding, and developing high-quality rice varieties remains a key objective for future breeding efforts [4–7].

During the processes of natural and artificial selection, rice has undergone significant genetic differentiation, resulting in the formation of the following two subspecies: indica and japonica. Molecular biology evidence suggests that the divergence between these
subspecies occurred approximately 4000 years ago [1,8,9]. Indica rice, which is tolerant to strong light and heat, is primarily found in regions with lower latitudes and altitudes. Its grains are long, slender, and tend to break easily during processing, resulting in a lower milling yield and grains that are more expansive but less sticky [1]. Japonica rice, on the other hand, is cold-tolerant, and is sensitive to high temperatures. It is mainly distributed in the northern parts of China, the middle and lower reaches of the Yangtze River, and the high-altitude areas of the Yunnan–Guizhou Plateau [10]. Japonica rice grains are more oval-shaped and shorter, which makes them less likely to break during milling, leading to a higher milling yield. Furthermore, there are significant differences in the quality traits between indica and japonica rice [11]. In addition to genetic characteristics, regional factors such as soil nutrient content, temperature, humidity, and precipitation also influence the differences in rice quality between these subspecies [12–14].

Rice quality encompasses four aspects, as follows: processing quality, appearance quality, cooking and taste quality, and nutritional quality [15]. It is generally believed that quality traits are quantitative, controlled by multiple genes, and that their inheritance patterns are complex [6,16–18]. The quality of rice is primarily determined by the genetic characteristics of the variety, environmental factors, and cultivation management practices combined [16,19–21]. Rice quality has increasingly become a focus for breeders, and some researchers have conducted studies on the trends in rice quality among approved varieties in China. An analysis of rice quality data from 635 approved rice varieties between 2000 and 2014 revealed improvements in the rice quality of hybrid indica, conventional japonica, and hybrid japonica [22]. These enhancements were particularly evident in metrics such as chalkiness degree, chalky rice rate, amylose content, and gel consistency [22]. Using nearly 20 years of tested rice quality data, researchers found that the head milled rice rate is a significant indicator that currently limits the production of high-quality rice [23]. According to the China Rice Industry Development Report, researchers analyzing data from the past decade identified that the head milled rice rate for indica rice has become a crucial limiting factor in the development of high-quality indica rice [24].

Developing high-yield, high-quality rice varieties is one of the focal points of future research [5,25,26]. While earlier studies have noted a contradiction between rice quality and yield [27], more recent researches indicate that optimizing yield components and selecting appropriate correlated genes can achieve a recombination of high-quality and high-yield, leading to the development of new rice varieties that excel in both aspects [28,29]. Wang et al. [30] discovered that the Glucan Water Dikinase 1 (GWD1) gene is a key factor in enhancing rice yield and improving rice quality, with changes in its expression significantly affecting critical traits such as yield, grain shape, and rice quality. Liu et al. [7] found that the qLGY3 gene plays a crucial role in simultaneously improving rice yield and quality. This gene contributes to increasing the length–width ratio of rice grains, reducing the rate and degree of chalkiness, and enhancing rice yield. Fang et al. [31] identified the LNUE1 gene as a critical factor in regulating rice nitrogen utilization and impacting yield and quality, which is significant for the coordinated improvement of both yield and quality. There is also a complex interplay among rice quality attributes, with certain correlations existing between different quality traits [32].

In recent years, variations and trends in rice quality across different types of approved varieties in China still lacked substantial big data support. This study collected trait data for 17,785 rice varieties approved at the provincial and national levels across China. These varieties were then categorized into five main types, as follows: indica inbred (II), indica hybrid (IH), japonica inbred (JI), japonica hybrid (JH), and indica-japonica hybrid (IJ). We analyzed the differences among the five rice types, also the trends in rice quality for these different types, and examined the relationships among grain quality traits. This analysis aims to provide data support for the coordinated improvement of rice quality, promoting the development of high-quality rice varieties.
2. Materials and Methods

This study collected information on 17,785 rice varieties approved in various provinces and nationally in China from 1978 to 2022. The primary data sources were the China Rice Data Center (http://www.ricedata.cn, accessed on 6 December 2022), the China National Knowledge Infrastructure (www.cnki.net, accessed on 20 January 2023), the China Crop Germplasm Resources Information Network (http://www.cgris.net/, accessed on 11 February 2023), and annual provincial crop variety approval reports. The varieties were then categorized into the following five types: II, IH, JI, JH, and IJ. The grain quality traits of these rice varieties include the brown rice rate (BRR), the head milled rice rate (HRR), transparency (T), the chalky rice rate (CRR), the chalkiness degree (CD), amylase content (AC), gel consistency (GC), the alkali value (AV), and the grain protein content (PC).

In this study, we utilized a series of statistical analyses to rigorously examine the quality variations across different rice types, and the trends of agronomic traits for different rice types from 1978–2022. Initially, one-way ANOVA was employed to determine the differences in rice quality among various types. To further refine these results, we applied the Least Significant Difference (LSD) test for multiple comparisons, which helped in identifying specific group pairs with significant differences in rice quality. Following the ANOVA, we used univariate linear regression to analyze the trends in rice quality over time for each rice type. This method provided insights into whether the quality traits increased or decreased over the studied period. To deepen our understanding of how agronomic traits are interrelated across different types of rice, we conducted Principal Component Analysis (PCA). PCA helped in reducing the dimensionality of our dataset by identifying principal components that explain a significant portion of the variance in agronomic traits. This analysis was crucial for discerning underlying patterns in the data that might not be apparent from direct observation. To better adhere to the assumptions of normality and homogeneous variances, we scaled the trait values. Furthermore, we limited our focus to six quality traits due to a high number of missing data points in PC, AV, and T. Mean factor loading values of different rice types on the first two axes were also tested using ANOVA to examine whether the rice types differed significantly along the PCA axes. All statistical analyses and the generation of graphical plots were performed using R 4.3.2.

3. Results

3.1. Variability in Agronomic Traits among Different Rice Varieties

This study collected agronomic trait data for 17,785 rice varieties, including 11,083 IH varieties, accounting for 62.29%; 1830 II varieties, accounting for 10.29%; 524 JH varieties, accounting for 2.95%; 4202 JI varieties, accounting for 23.62%; and 146 IJ varieties, accounting for 0.82%.

For processing quality, the BRR is significantly higher in JI (82.87%) compared with JH (82.46%), which in turn is significantly higher than IJ (81.56%), followed by IH (80.87%), which is, finally, significantly higher than II (80.17%) (Figure 1a). Although there are significant differences between some types, the numerical differences in the BRR are relatively small. The coefficient of variation (CV) for the BRR is quite small across all types, suggesting that the BRR is consistently similar within each type. Regarding the HRR, JI exhibits the highest median value at 69.06%, which is statistically higher than II (67.43%), followed by IH (67.01%) (Figure 1b). Similarly, there is no significant difference between II (59.08%) and IH (59.04%) (Figure 1b). However, the CV of the HRR for II (15.75%) and IH (14.69%) is significantly higher than for JI (7.03%) and JH (8.31%) (Figure 1b). This suggests greater variability in the HRR among the II and IH types, compared with the more consistent rates observed in JI and JH types.
niificantly higher than for JI (7.03%) and JH (8.31%) (Figure 1b). This suggests greater vari-
ability in the HRR among the II and IH types, compared with the more consistent rates
observed in JI and JH types.

Figure 1. Differences in trait values among rice types. (a) Brown rice rate, (b) head milled rice rate,
(c) transparency, (d) chalky rice rate, and (e) chalkiness degree. The five types are: indica inbred (II),
indica hybrid (IH), japonica inbred (JI), japonica hybrid (JH), and indica-japonica hybrid (IJ). Different
letters above a column indicate a significant difference (p < 0.05).

Regarding appearance quality, there are no significant differences in transparency
values among II (1.71), JH (1.64), and IJ (1.58); however, all three are significantly higher
than IH (1.51) and JI (1.27) (Figure 1c). Additionally, IH demonstrates significantly higher
transparency values compared with JI, indicating that the grains for JI are the most trans-
parent (Figure 1c). The CV for the transparency values of each type is quite high, averaging
42.52%. Regarding the CRR, there are no significant differences between IH (31.38%) and
JH (29.03%), although both are significantly higher than other types (Figure 1d). II (24.82%)
is significantly higher than IJ (20.03%) and JI (15.02%), with II also being significantly higher
than JI (Figure 1d). This indicates a clear variation in the appearance quality related to chalkiness across different rice types, likely reflecting genetic and environmental influences specific to each type. Additionally, each type exhibits a higher average CV of 79.91%, with IH showing an exceptionally high CV of 123.15%. This substantial variability could be attributed to the inclusion of glutinous rice varieties within each group. For CD, IH (5.41%) is significantly higher than JH (4.46%), JI (3.00%), and IJ (3.31%), although there is no significant difference when compared with II (Figure 1e). II exhibits a significantly higher CD than JI and JI, but not the case compared with JH (Figure 1e). Meanwhile, JH is significantly higher than JI, but shows no significant difference to IJ (Figure 1e). Similarly, the CV for the CD is higher for each type, mirroring the pattern observed with the CRR.

For cooking and taste quality, AC significantly differs across each type, exhibiting a trend of IH (17.95%) > II (17.50%) > JI (16.14%) > JH (15.34%) (Figure 2a). GC shows no difference among IJ (75.71 mm), JH (74.86 mm), and JI (74.71 mm), indicating similar textural properties among these types; however, it is significantly higher in these groups compared with II (69.50 mm) and IH (68.65 mm) (Figure 2b). Additionally, II exhibits a significantly higher GC than IH (Figure 2b). For AV, II (8.7) is significantly higher than other types. The values do not differ significantly among IJ (6.56), JH (6.48), and JI (6.85) (Figure 2c). Furthermore, there was no significant difference among IJ, JH, and IH (6.31); however, JI is significantly higher than IH (Figure 2c).

![Figure 2. Differences in trait values among rice types. (a) Amylose content, (b) gel consistency, (c) alkali value, and (d) grain protein content. Figure explanations are provided in Figure 1.](image-url)

For nutrient content, the PC in II (9.29%) is significantly higher than in IH (8.90%), JH (8.53%), and JI (7.91%), but not significantly different from IJ (9.13%) (Figure 2d). Additionally, no significant differences in PC are observed among IH, JH, and IJ, but all are significantly higher than JI (Figure 2d).
3.2. Trends in Grain Quality across Various Rice Varieties from 1978 to 2022

In assessing grain quality over several decades, notable trends have emerged in the processing and sensory attributes of various rice varieties. BRR has significantly decreased for IH, JH, and JI, though the correlation coefficients indicate that these changes are relatively modest. Conversely, there are no significant changes observed for II and IJ (Figure 3a). Regarding the HRR, there is a notable increase across all rice types, except for IJ (Figure 3b). Regarding appearance quality, transparency has significantly decreased in all rice types except for IJ (Figure 3c). This trend is mirrored in the CRR and CD (Figure 3d,e). For cooking and taste quality, AC significantly increases only in IJ, while it decreases in all other varieties (Figure 4a). GC significantly increases for indica varieties, but decreases for japonica types (Figure 4b). AV shows significant increases for II and IH, while no significant changes are reported for the other types (Figure 4c). For nutrient content, the PC significantly decreases in all varieties except for IJ (Figure 4d).

Figure 3. Trends in grain quality across various rice varieties from 1978 to 2022. (a) Brown rice rate, (b) head milled rice rate, (c) transparency, (d) chalky rice rate, and (e) chalkiness degree. The five types are: indica inbred (II), indica hybrid (IH), japonica inbred (JI), japonica hybrid (JH), and indica-japonica hybrid (IJ). Pearson correlation coefficients (R) and their significance level (p) are shown (p < 0.05).
Figure 4. Trends in grain quality across various rice varieties from 1978 to 2022. (a) Amylose content, (b) gel consistency, (c) alkali value, and (d) grain protein content. Figure explanations are provided in Figure 3.

3.3. Trait Coordination in Rice Varieties: Principal Component Analysis

The first two principal components (PCs) extracted from the analysis accounts for a considerable proportion of the variability within the dataset, with 43.11% for PC1 and 23.01% for PC2 (Figure 5a). The loadings on PCA axis 1 are associated with appearance quality, as well as cooking and taste quality, including AC, CRR, CD, and GC. The second PCA axis is primarily structured by processing traits, including BRR and HRR. PC1 significantly separates the types, except for JI and IJ (Figure 5b,c), while PC2 significantly separates the types, except for IJ and IH (Figure 5b,d). These results suggest that both the subspecies differentiation and hybridization status significantly influence the quality traits of rice varieties.
Figure 5. A Principal Component Analysis on six quality traits of the studied rice varieties. (a) Loading of the six traits on the first two axes; (b) varieties’ loadings on the first and second axes; (c) box-plots of varieties’ scores on PC1; (d) box-plots of varieties’ scores on PC2. Abbreviations for Figure 5a: brown rice rate (BRR), head milled rice rate (HRR), chalky rice rate (CRR), chalkiness degree (CD), amylose content (AC), and gel consistency (GC). The five types are: indica inbred (II), indica hybrid (IH), japonica inbred (JI), japonica hybrid (JH), and indica-japonica hybrid (IJ). Different letters above a column indicate a significant difference (p < 0.05).

4. Discussion

Rice not only provides energy and essential proteins, but also contains active ingredients like iron, zinc, γ-aminobutyric acid, and vitamins [33]. These components improve human metabolism, fulfill nutritional needs, and help prevent diseases, thereby offering significant health benefits [34]. In this study, we observed that japonica inbreds and hybrids excel in both processing and cooking qualities, showcasing higher BRR and HRR, along with longer GC. These varieties are distinguished by their lower AC, which contributes to a softer, more palatable rice texture. Inbred varieties, which include both indica and japonica types, tend to exhibit a lower CRR compared with their hybrid counterparts, indicating superior appearance quality. Additionally, indica inbreds have the highest PC; while this is nutritionally advantageous, it may negatively impact the rice’s texture and flavor, potentially reducing consumer satisfaction.

Our findings align with previous analyses that found japonica rice to have higher BRR, HRR, longer GC, and lower AC than indica rice [23,35,36]. However, the patterns of CRR and CD were different [36], and we did not find significant differences for CD between II and JH, nor significant differences for CRR between IH and JH. All of the rice quality traits of JI are also generally better than that of JH, which corroborates the results found by
most researches [37], but contrasts with the findings of Feng [22], likely due to the different number of rice varieties collected in each study. The BRR, PC, and transparency of IH are better than those of II, but other indicators, such as the CRR, AC, and GC, are inferior to conventional indica, particularly the average CRR of IH, which reaches 31.38%, and is significantly higher than the 24.82% of II. This contrasts with the findings reported by Feng [22], which may be attributed to the smaller sample size of II varieties (24 varieties) analyzed by Feng, compared with the 1830 varieties examined in this study. It is important to note that differences in rice quality among different rice types are influenced not only by the genetic characteristics of the varieties, but also by environmental conditions in the cultivation areas. Over the past 20 years, due to the excellent quality of japonica rice, the planting area of japonica rice in China has increased from 5.945 million hectares in 2003 to 10.142 million hectares in 2018, with many regions in the Yangtze River basin shifting from indica to japonica rice [38].

Processing quality refers to the products obtained from milling rice, and is typically assessed using indicators such as the BRR and the HRR [39]. Research on the rice quality of approved rice varieties in China has revealed that the BRR of IH, JI, and JH has significantly decreased over time, though the reduction is relatively small. In contrast, the HRR for all indica and japonica rice has shown a trend of significant increase, but the increase is also relatively small. These results differ from those found in the study by Feng [22], possibly due to differences in the time periods studied and the sample sizes used in the two studies. The findings of this research also differ from those of Zeng [40], potentially because their analysis was limited to 710 high-quality rice varieties selected from a total of 1797 varieties cultivated in southern China.

In terms of appearance quality, both II and IH rice varieties have experienced significant decreases in CRR, CD, and transparency values. These findings are consistent with prior research conducted by Feng et al. [22], Zeng et al. [40], Lv et al. [41], and Xianqiao Hu et al. [23]. Moreover, Hu and colleagues argue that due to these improvements, appearance quality is no longer the primary factor limiting the production of high-quality rice for indica rice [23]. We also found significantly decreased CRR, CD, and transparency values for japonica rice, which is similar to Lv et al. [41] and Feng et al. [22], but differs from Zeng et al. [40].

Cooking and taste quality are important indicators of rice quality, and significant factors affecting rice prices. GC, AC, and AV are crucial metrics for assessing the cooking and taste quality of rice [39,42]. The results of this study revealed that the AC in all rice types, except for IJ, significantly decreased over time, with IH experiencing the largest changes. Accordingly, the GC of indica rice showed a significant increasing trend. AC is a key factor in determining grain transparency, palatability, stickiness, and digestibility characteristics, which are related to the hardness, elasticity, and stickiness of cooked rice [39]. Generally, rice with medium to low AC is softer, more palatable, and has a better gloss, while rice with high AC tends to be harder and less palatable [43]. The type of soft rice characterized by low AC is increasingly favored by consumers due to its enhanced eating and cooking quality [44]. GC is significantly negatively correlated with AC (Figure 5a). The decrease of AC leads to longer GC, thus improving rice cooking quality [45].

Grain protein content is a pivotal determinant of rice’s nutritional quality, significantly influencing both eating and cooking characteristics. However, research by Yang et al. (2019) indicates that there is a negative correlation between PC and GC, suggesting that higher protein levels might detrimentally affect the texture and overall culinary quality of rice [26]. This relationship poses a challenge, as optimal PC can enhance nutritional value but potentially compromise palatability and cooking performance [46]. Therefore, developing new strategies to balance nutritional quality with superior eating and cooking qualities in rice is critically important. This balance is essential not only for meeting consumer preferences, but also for addressing dietary needs, making it imperative for ongoing breeding programs to consider these factors comprehensively.
Indica-japonica hybrid rice varieties (IJ) represent a breakthrough in rice breeding by effectively combining the genetic strengths of both the indica and japonica subspecies. These hybrids are characterized by their enhanced adaptability and stability across diverse environmental conditions. They frequently achieve higher yields compared with their parental strains, and exhibit improved resilience against a broad spectrum of climatic stresses [45]. We found that IJ typically exhibits a balance in BRR and HRR that is intermediate between the two parent subspecies. Additionally, they are characterized by lower CRR and the lowest AC among the rice types, contributing to longer GC. This unique combination of traits suggests that IJ varieties could significantly enhance both the taste and processing efficiency of rice. The potential of IJ rice in the global market is substantial, given its advantageous agronomic and quality attributes. Moreover, considering the current limited number of IJ varieties available in the market, there is a clear opportunity to increase their presence through targeted breeding and marketing strategies [47].

5. Conclusions

This study collected and analyzed rice quality data for 17,785 rice varieties approved in China. The results revealed notable differences and trends in rice quality among these types. Japonica inbred and hybrid varieties excelled in processing and cooking qualities, showing higher BRR, HRR, and longer GC, alongside lower AC. In contrast, indica inbreds exhibited the highest PC, which may negatively affect texture and flavor. Over several decades, significant increases in HRR were observed across all types except for IJ, while transparency, CRR, and CD generally declined, indicating improvements in appearance quality. The study underscores the importance of balancing yield, quality, and adaptability in future rice breeding efforts, providing substantial data and theoretical insights to support these endeavors.

Author Contributions: Conceptualization, R.L. and M.L.; methodology, Y.L.; software, R.L.; validation, J.Z.; formal analysis, Y.T. and R.L.; investigation, Y.L., S.L. and X.L.; resources, Y.L. and S.L.; data curation, Y.L.; writing—original draft preparation, Y.L., Y.T. and M.L.; writing—review and editing, Y.L., J.Z. and M.L.; visualization, R.L.; supervision, R.L., J.Z. and M.L.; project administration, R.L. and M.L.; funding acquisition, M.L. and J.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Science and Technology Planning Project of Guangdong Province of China (2021B0202030002), the Basic and Applied Basic Research Fund of Guangdong (2020A1515110143, 2022A1515011450), and the Guangdong Key Laboratory of New Technology in Rice Breeding (2023B1212060042).

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: We extend our sincere thanks to the China Rice Data Center (http://www.ricedata.cn, accessed on 6 December 2022) for providing agronomic traits data of approved rice varieties covering the period from 2017 to 2022.

Conflicts of Interest: The authors declare no conflicts of interest.

References
21. Zhang, T.Y.; Huang, Y.; Yang, X.G. Climate warming over the past three decades has shortened rice growth duration in China and
25. Zhao, F.; Liu, J.; Cao, G.-Y.; Du, J.; Cui, J.; Xiang, C.-Y.; Guo, S.-L. Discussion on grain quality in breeding and cultivation of rice. Hybrid Rice 2022, 37, 1–6. [CrossRef]
43. Liu, X.D.; Ding, Q.; Wang, W.S.; Pan, Y.L.; Tan, C.; Qiu, Y.B.; Chen, Y.; Li, H.J.; Li, Y.L.; Ye, N.Z.; et al. Targeted Deletion of the First Intron of the Wx(b) Allele via CRISPR/Cas9 Significantly Increases Grain Amylose Content in Rice. Rice 2022, 15, 1. [CrossRef]
46. Shi, S.; Wang, E.; Li, C.; Cai, M.; Cheng, B.; Cao, C.; Jiang, Y. Use of Protein Content, Amylose Content, and RVA Parameters to Evaluate the Taste Quality of Rice. Front. Nutr. 2022, 8, 758547. [CrossRef]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.