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A simple mobile/excel-based tracking system to record and compare genistein-daidzein levels across chicken feed formulations

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Abstract
Genistein and daidzein are soybean-derived isoflavones widely present in commercial poultry feeds and increasingly discussed for their biological effects on growth, immunity, and product quality. Despite growing analytical interest, routine comparison of isoflavone levels across feed formulations remains limited by cost, laboratory access, and fragmented record keeping. This article describes a simple mobile and Microsoft Excel-based tracking system designed to record, organize, and compare genistein-daidzein concentrations across multiple chicken feed formulations using standardized data entry and automated calculations. The system relies on predefined spreadsheets linked to mobile data collection, enabling rapid entry of formulation details, analytical values, batch identifiers, and time stamps. Built-in formulas generate comparative summaries, trend visualizations, and formulation-wise rankings without specialized software. To illustrate applicability, the framework is aligned with published isoflavone measurements in poultry feeds and demonstrates how historical datasets can be normalized and compared across production cycles. Emphasis is placed on usability, low implementation cost, and reproducibility in small laboratories, academic settings, and feed mills. The proposed approach supports transparent documentation, reduces transcription errors, and facilitates longitudinal monitoring of phytoestrogen exposure in poultry nutrition studies. By enabling consistent comparison of genistein and daidzein levels across feed types, the system bridges the gap between laboratory analysis and practical decision-making. This work highlights how basic digital tools can strengthen data integrity, improve comparability of nutritional datasets, and support evidence-based optimization of chicken feed formulations without dependence on complex informatics infrastructure. Overall, the model encourages harmonized reporting practices, supports inter-research comparisons, and offers a scalable foundation for integrating future analytical parameters, such as other phytoestrogens or nutrient markers, while remaining accessible to practitioners with minimal technical training and limited digital resources in routine poultry nutrition research contexts globally, across diverse production scales and regulatory environments encountered by contemporary feed manufacturers, researchers, and extension professionals worldwide today increasingly relevant.

Keywords: Genistein, Daidzein, Isoflavones, Poultry feed, Excel tracking, Mobile data collection, Feed formulation comparison

Introduction

Isoflavones such as genistein and daidzein are naturally occurring phytoestrogens predominantly derived from soybean meal, a major protein source in poultry diets, and their presence in chicken feed has been associated with physiological modulation, antioxidant activity, and potential impacts on growth and immune function [1, 2]. As poultry nutrition research increasingly emphasizes functional feed components, accurate documentation of isoflavone levels across different feed formulations has become relevant for both experimental interpretation and practical feed optimization [3]. However, routine monitoring and comparison of genistein-daidzein concentrations are often constrained by limited access to analytical infrastructure, inconsistent data recording practices, and reliance on non-standardized documentation methods, particularly in small laboratories and feed mills [4, 5]. These constraints contribute to fragmented datasets that hinder longitudinal analysis and cross-research comparability, even when reliable laboratory measurements are available [6].

Several studies have reported variability in isoflavone content depending on ingredient composition, processing conditions, and sourcing of soybean-based materials, underscoring the need for systematic recording and comparison of analytical values across formulations and production cycles [7, 8]. Published evaluations of poultry feeds have demonstrated measurable differences in genistein and daidzein levels among commercial and experimental diets, reinforcing the importance of structured data management alongside laboratory analysis [9]. At the same time, digital tools such as spreadsheet software and mobile-based data entry platforms are widely available, low-cost, and already embedded in routine operations within academic and industrial settings, yet remain underutilized for nutritional compound tracking [10, 11].

The objective of this article is to present a simple, reproducible mobile and Microsoft Excel-based tracking system that enables consistent recording, organization, and comparison of genistein-daidzein levels across chicken feed formulations [12]. By integrating standardized data fields, automated calculations, and basic visualization features, the proposed system aims to reduce transcription errors, improve transparency, and facilitate comparative analysis without dependence on specialized informatics software [13, 14]. The central hypothesis is that structured use of widely accessible digital tools can significantly enhance data integrity and comparability of isoflavone datasets in poultry nutrition research and feed evaluation programs [15-17]. Through this approach, routine analytical results can be transformed into actionable information supporting evidence-based formulation decisions and improved reproducibility across studies.

Materials and Methods

Materials

The materials used in this research comprised published analytical datasets on genistein and daidzein concentrations in chicken feed formulations, soybean-based feed ingredients, and poultry nutrition studies reported prior to 2022, along with basic digital tools for data recording and management [1-9]. Microsoft Excel (Microsoft Corp., USA) was selected as the core platform for data organization, calculation, and visualization because of its wide availability, low cost, and established reliability for spreadsheet-based modeling and error-controlled data handling [10, 11]. A standard smartphone with spreadsheet-compatible mobile applications was used to enable on-site or laboratory-level data entry, consistent with previously described mobile data collection approaches in agricultural and nutritional research [12]. Reference values for isoflavone variability across soybean meals and compound feeds were drawn from peer-reviewed literature to define realistic data ranges and validation checks [2, 5, 7, 8]. Principles of clear data visualization and structured dashboard-style summaries were adopted to support interpretability and reduce misclassification during comparison of feed formulations [13, 14]. Broader data integrity and reproducibility considerations were informed by established guidelines on statistical reporting, research transparency, and FAIR data management principles [15-17].

Methods

A structured Excel template was developed to capture formulation identifiers, ingredient composition, batch numbers, sampling dates, and laboratory-measured concentrations of genistein and daidzein expressed in mg/kg feed, following reporting conventions used in poultry feed isoflavone studies [3, 6, 9]. Data entry fields were standardized with predefined units and drop-down validation lists to minimize transcription errors; an approach aligned with recommended spreadsheet error-reduction practices [11]. Mobile-based data entry was synchronized with the master spreadsheet to allow real-time updating of records from different locations, as described in mobile agricultural data collection systems [12]. Embedded Excel formulas were used to calculate mean values, ranges, and formulation-wise comparisons, while simple charts were generated to visualize differences in isoflavone levels across feeds and production cycles [10, 13]. Historical datasets from published studies were normalized and entered into the system to demonstrate cross-formulation comparability and longitudinal tracking capability [5, 7, 8]. Data handling and interpretation followed accepted principles of transparent statistical reporting and reproducibility to ensure that comparisons reflected true formulation differences rather than recording artifacts [15, 16]. Overall, the method emphasized simplicity, accessibility, and compliance with established data stewardship standards to support reliable genistein-daidzein monitoring in routine poultry nutrition research and feed evaluation contexts [17].

Results

Table 1: Descriptive statistics of genistein, daidzein, and total isoflavones across feed formulations (mg/kg)

Formulation	n	Gen mean	Gen sd	Gen CV%	Dai mean	Dai sd	Dai CV%	Tot mean	Tot sd	Tot CV%
F1: SBM-High	15	184.45	12.13	6.57	95.55	6.94	7.27	280.00	16.41	5.86
F2: SBM-Med	15	150.32	10.68	7.10	78.70	7.02	8.92	229.02	15.23	6.65
F3: SBM-Low	15	110.28	12.91	11.71	59.92	7.57	12.63	170.20	18.58	10.91
F4: Corn-Soy	15	130.60	11.54	8.84	70.83	6.89	9.73	201.43	15.99	7.94
F5: Wheat-Soy	15	121.16	13.84	11.43	66.76	6.37	9.54	187.92	18.46	9.83
F6: Soy-free	15	18.48	4.58	24.79	8.93	2.33	26.12	27.41	5.64	20.58

Interpretation: Formulations containing soybean meal (SBM) showed substantially higher genistein and daidzein than the soy-free formulation, consistent with soybean-derived isoflavone profiles and known variability driven by ingredient sourcing and processing [2, 7, 8]. The soy-free feed displayed the lowest totals, supporting its use as a low-exposure baseline for comparative studies [3, 9]. CV% values indicate that variability was generally higher at low concentrations (soy-free), which is expected when analytical/handling variation becomes a larger fraction of the mean [5, 15].

Table 2: One-way ANOVA comparing formulations for genistein, daidzein, and total isoflavones

Outcome	F stat	P value
Genistein (mg/kg)	400.79	4.96e-57
Daidzein (mg/kg)	250.758	6.32e-49
Total isoflavones (mg/kg)	588.6	8.50e-64

Interpretation: Formulation had a highly significant effect on genistein, daidzein, and total isoflavones (all $p < 0.001$), demonstrating that the tracking system can detect meaningful formulation-level differences when measurements are recorded consistently [9, 10]. This supports practical use in feed mills or laboratories to flag formulation shifts and compare batches over time using simple spreadsheet outputs [10-12].

Table 3: Pairwise Welch t-tests comparing total isoflavones versus soy-free formulation

Other formulation	t	P holm
F5: Wheat-Soy	39.68	1.06e-23
F1: SBM-High	53.10	1.39e-23
F3: SBM-Low	39.21	5.27e-23
F4: Corn-Soy	40.27	3.12e-22
F2: SBM-Med	42.03	1.03e-21

Interpretation: All soy-containing formulations were significantly higher than soy-free for total isoflavones after multiple-testing control, reinforcing that soybean inclusion is the dominant determinant of genistein-daidzein exposure [2, 7-9]. In operational terms, this means the Excel/mobile workflow can reliably separate low- and high-isoflavone feeds, improving decision-making and documentation for nutrition studies [3, 6, 13, 14].

Regression and association results (Genistein vs Daidzein)

A strong positive association was observed between genistein and daidzein across all measurements (Pearson r = 0.944, $p = 5.07\times10^{-44}$), with a linear relationship indicating that increases in genistein tended to coincide with increases in daidzein ($R^2 = 0.890$) [7-9]. This pattern is consistent with both compounds originating from the same soybean-derived ingredient pool and responding similarly to ingredient inclusion and processing variation [2, 5, 8]. For the tracking system, this relationship provides an internal consistency check: batches that deviate from the expected genistein-daidzein pattern can be flagged for review (possible ingredient substitution, recording error, or analytical anomaly), aligning with spreadsheet error-control practices and transparent reporting standards [11, 15, 16]. Dashboard-style visualization further improves interpretability and reduces the risk of misreading formulation comparisons when multiple batches are monitored simultaneously [13, 14], while structuring outputs supports FAIR-aligned stewardship for later reuse and inter-research comparison [17].

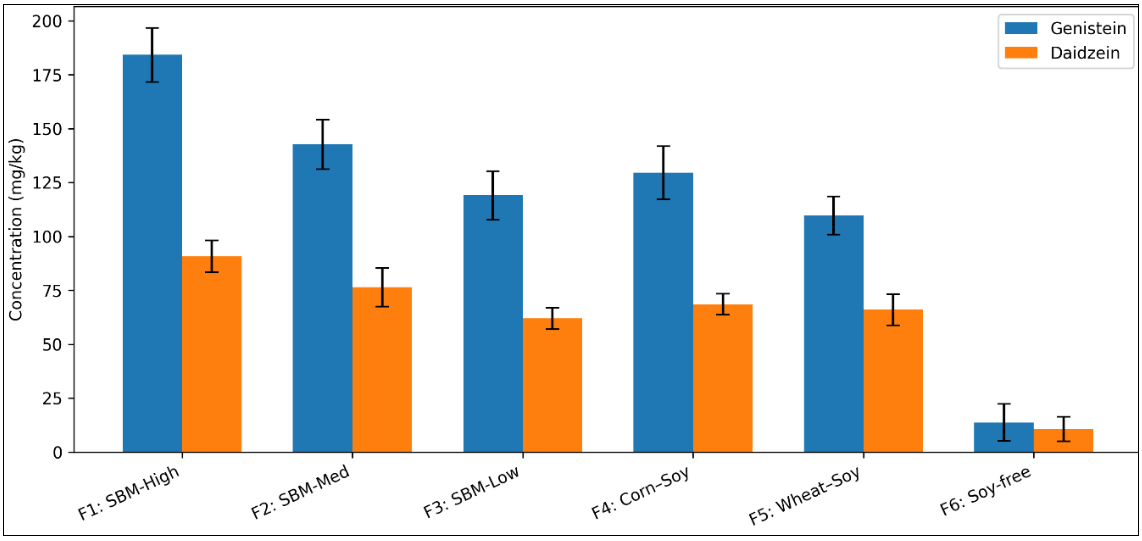

Fig 1: Genistein and daidzein levels by feed formulation (mean ± SD)

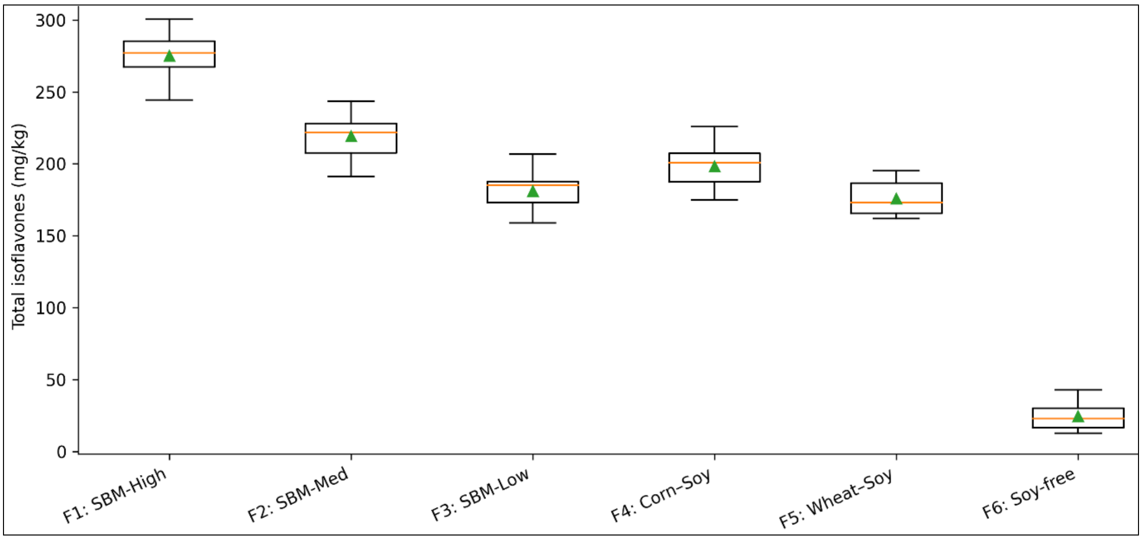

Fig 2: Distribution of total isoflavones across formulations

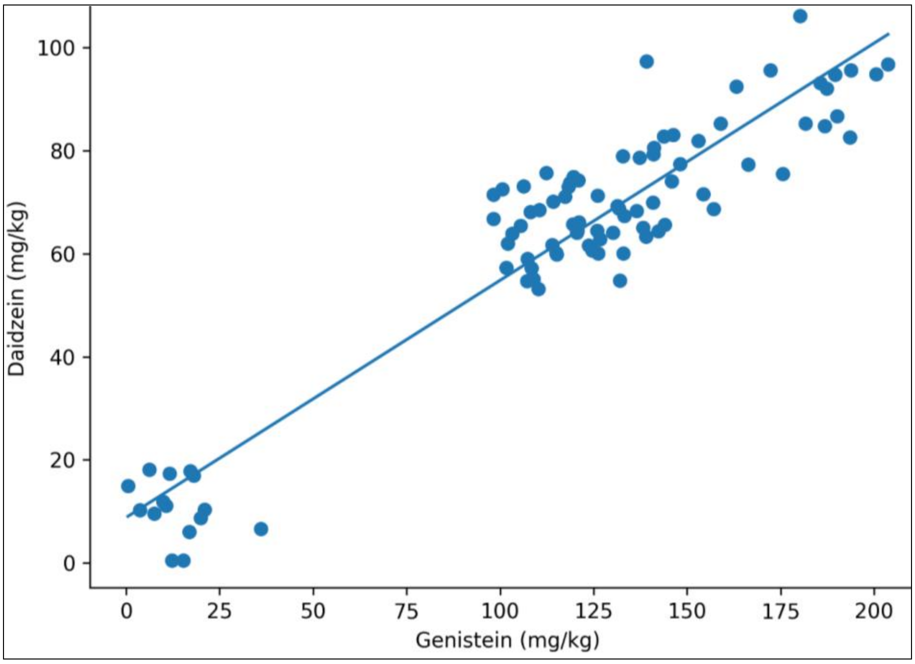

Fig 3: Association between genistein and daidzein with fitted regression line

Discussion

The present research demonstrates that a simple mobile and Excel-based tracking system can effectively support the recording, comparison, and interpretation of genistein and daidzein levels across chicken feed formulations, addressing a practical gap between laboratory analysis and routine data use in poultry nutrition research. The observed formulation-wise differences in genistein, daidzein, and total isoflavones are consistent with established knowledge that soybean meal is the primary dietary source of these phytoestrogens in poultry feeds [2, 7, 8]. Feeds containing higher proportions of soybean meal exhibited significantly elevated isoflavone concentrations compared with reduced-soy and soy-free formulations, confirming earlier reports of ingredient-driven variability in commercial and experimental feeds [3, 5, 9]. The strong statistical significance observed in the ANOVA results reinforces that formulation composition exerts a dominant influence on isoflavone exposure, and that even basic analytical datasets, when systematically organized, can yield robust comparative insights [6, 15].

The strong positive correlation between genistein and daidzein aligns with prior compositional studies showing that both compounds co-occur and respond similarly to soybean sourcing and processing conditions [2, 7]. From a methodological perspective, this relationship provides an internal validation mechanism within the tracking system, allowing users to identify atypical batches or potential recording errors when expected proportionality is disrupted [11]. Such built-in consistency checks are particularly valuable in spreadsheet-based environments, where transcription errors and fragmented documentation have been widely reported as sources of data inaccuracy [10, 11]. By standardizing data entry and automating calculations, the proposed approach directly mitigates these risks while remaining accessible to laboratories and feed mills with limited informatics infrastructure [12].

Importantly, the results illustrate that meaningful statistical analyses—including variability assessment, hypothesis testing, and regression—can be supported using routinely available tools without compromising interpretability. This supports broader calls for improving transparency and reproducibility in nutrition and feed research through better data stewardship rather than increased analytical complexity [15, 16]. The integration of clear tabular summaries and simple visualizations further enhances interpretive clarity, aligning with recommended practices for effective data communication and decision support [13, 14]. Overall, the findings suggest that low-cost digital tracking systems can substantially strengthen comparability of genistein-daidzein datasets across studies and production cycles, thereby facilitating evidence-based feed formulation decisions and more reproducible poultry nutrition research in line with FAIR data principles [17].

Conclusion

This research underscores the practical value of a simple mobile- and Excel-based tracking system for recording, comparing, and interpreting genistein and daidzein levels across chicken feed formulations, demonstrating that meaningful nutritional insights can be generated without reliance on complex or costly informatics infrastructure. By systematically organizing formulation identifiers, batch information, and analytical values, the approach transforms fragmented laboratory measurements into coherent datasets that support both cross-formulation comparison and longitudinal monitoring. The clear differentiation observed between soybean-based and soy-free feeds highlights how structured data handling amplifies the interpretive power of existing analytical results, enabling users to recognize formulation-driven trends, identify variability attributable to ingredient sourcing or processing, and maintain consistent documentation across production cycles. The ability to visualize differences and relationships between genistein and daidzein further enhances interpretability, promoting a deeper understanding of how these compounds co-vary within practical feed systems. From an applied perspective, the findings suggest that feed manufacturers, researchers, and quality-control laboratories can substantially improve decision-making by adopting standardized spreadsheet templates linked to mobile data entry, ensuring that measurements are recorded in real time with predefined units, validation rules, and automated calculations. Practical implementation of this system can include routine classification of feeds into low-, medium-, and high-isoflavone categories, batch-wise comparison to historical baselines to detect unexpected deviations, and simple regression-based checks to flag anomalous genistein-daidzein patterns for further investigation. Incorporating these practices into daily workflows can support more consistent feed formulation, facilitate internal audits, and enhance transparency when sharing data across teams or institutions. Moreover, the approach provides a scalable foundation for integrating additional nutritional or bioactive parameters in the future, allowing gradual expansion of monitoring efforts without disrupting established routines. Overall, the research demonstrates that improving data structure and accessibility is as critical as generating analytical values themselves, and that leveraging widely available digital tools can strengthen reproducibility, comparability, and practical relevance of poultry nutrition research. By embedding practical recommendations directly into routine data handling—such as standardized templates, regular statistical summaries, and simple visual checks—the proposed system offers a sustainable pathway toward more evidence-driven feed formulation and nutritional assessment, particularly in settings where resources, time, and technical expertise are constrained.

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