



Comparative Evaluation of Moisture Content and Melting Point Characteristics of Commercial Aspirin Tablets Marketed In Tobruk, Libya

Adel Farjani*

Chemistry Department, Faculty of Science, Tobruk University, Tobruk, Libya

تقييم مقارن لمحتوى الرطوبة وخصائص درجة الانصهار لأقراص الأسبرين التجارية المتوفرة في أسواق طبرق، ليبيا

عادل فرجاني*

قسم الكيمياء، كلية العلوم، جامعة طبرق، طبرق، ليبيا

*Corresponding author: adelferjani22@yahoo.com

Received: August 14, 2026

Accepted: September 25, 2026

Published: October 22, 2026



Copyright: © 2026 by the authors. This article is an open-access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract:

Acetylsalicylic acid (aspirin) is a widely prescribed analgesic and antiplatelet agent that is susceptible to moisture-induced degradation. Monitoring moisture content and thermal behavior may provide useful preliminary information regarding physicochemical changes during storage. This study aimed to perform a laboratory-based comparative evaluation of moisture content and melting point characteristics among six commercial aspirin tablet products (75 mg) marketed in Tobruk, Libya, and to investigate the statistical relationship between these two physical parameters. Six commercially available 75 mg aspirin tablet products were purchased from community pharmacies in Tobruk, Libya, in May 2026. Moisture content (loss on drying) was determined using a halogen moisture analyzer (Mettler Toledo HB43-S) at 105°C until constant weight. Melting point measurements were performed on finely powdered tablet samples using a Stuart Scientific SMP3 digital melting point apparatus at a controlled heating rate of 1.0°C/min. All determinations were carried out in technical duplicates. Moisture content values ranged from 0.10% to 1.40% (mean = 0.70%), while melting point values ranged from 134.40°C to 136.50°C (mean = 135.45°C). Pearson correlation analysis demonstrated a statistically significant and very strong negative correlation between moisture content and melting point ($r = -0.992$, $p < 0.001$). Simple linear regression analysis showed that moisture content accounted for 98.3% of the observed variation in melting point values ($R^2 = 0.983$, $p < 0.001$). The findings indicate a strong inverse association between moisture content and melting point among the evaluated aspirin tablet products. Although melting point analysis provides useful preliminary screening information, comprehensive quality evaluation requires additional pharmacopoeial tests, including assay, dissolution testing, and degradation-product profiling.

Keywords: : Acetylsalicylic acid; Aspirin tablets; Moisture content; Loss on drying; Melting point; Physical stability;

المخلص

يُعد حمض الأسيتيل ساليسيليك (الأسبرين) مسكناً للألم وعاملاً مضاداً لتجمع الصفائح الدموية، وهو دواء يُوصف على نطاق واسع، لكنه عرضة للتحلل بفعل الرطوبة. لذا، فإن مراقبة محتوى الرطوبة والسلوك الحراري قد توفر معلومات أولية مفيدة حول التغيرات الفيزيائية والكيميائية التي قد تحدث أثناء التخزين. هدفت هذه الدراسة إلى إجراء تقييم مخبري مقارن لمحتوى

الرطوبة ودرجة الانصهار لستة منتجات تجارية من أقراص الأسبرين (بتركيز 75 ملجم) المتوفرة في مدينة طبرق بليبيا، بالإضافة إلى دراسة العلاقة الإحصائية بين هذين المتغيرين الفيزيائيين. تم الحصول على العينات من صيدليات مجتمعية في مدينة طبرق، ليبيا، في مايو 2026. قيس محتوى الرطوبة (الفقدان عند التجفيف) باستخدام جهاز تحليل الرطوبة الهالوجيني (Mettler Toledo HB43-S) عند درجة حرارة 105 مئوية حتى الوصول إلى وزن ثابت. كما تم قياس درجة الانصهار لعينات الأقراص بعد طحنها إلى مسحوق ناعم، وذلك باستخدام جهاز رقمي لقياس درجة الانصهار (Stuart Scientific SMP3) مع ضبط معدل التسخين عند 1.0 درجة مئوية/دقيقة. أجريت جميع القياسات بنظام التكرار التقني (مرتين لكل عينة). تراوحت قيم محتوى الرطوبة بين 0.10% و 1.40% (بمتوسط 0.70%)، بينما تراوحت درجات الانصهار بين 134.40 درجة مئوية و 136.50 درجة مئوية (بمتوسط 135.45 درجة مئوية). أظهر تحليل الارتباط لبيرسون وجود علاقة عكسية قوية جداً وذات دلالة إحصائية بين محتوى الرطوبة ودرجة الانصهار ($p < 0.001$, $r = -0.992$). كما أوضح تحليل الانحدار الخطي البسيط أن محتوى الرطوبة يفسر 98.3% من التباين الملاحظ في قيم درجة الانصهار ($R^2 = 0.983$, $p < 0.001$). تشير هذه النتائج إلى وجود علاقة عكسية قوية بين محتوى الرطوبة ودرجة الانصهار في منتجات أقراص الأسبرين التي خضعت للدراسة. وعلى الرغم من أن تحليل درجة الانصهار يوفر معلومات أولية مفيدة للفحص، إلا أن التقييم الشامل للجودة يتطلب إجراء اختبارات إضافية وفقاً لدساتير الأدوية، مثل اختبارات المعايير (التحليل الكمي)، واختبارات الذوبان، وتحديد نواتج التحلل.

الكلمات المفتاحية: حمض الأسيتيل ساليسيليك؛ أقراص الأسبرين؛ محتوى الرطوبة؛ الفقدان عند التجفيف؛ درجة الانصهار؛ الاستقرار الفيزيائي.

Introduction

Aspirin (acetylsalicylic acid, ASA) is a widely used pharmaceutical agent because of its analgesic, antipyretic, anti-inflammatory, and antiplatelet properties. Maintaining its stability during storage is essential to ensure product quality and therapeutic effectiveness. Moisture is one of the most important factors affecting aspirin stability. In the presence of water, aspirin undergoes hydrolysis to form salicylic acid and acetic acid (Figure 1), which may alter its physicochemical properties and reduce its stability. Previous studies have demonstrated the impact of moisture on aspirin degradation. Li et al. (2008) reported that increased humidity accelerated aspirin hydrolysis and reduced its stability, while Husejnović et al. (2025) showed that elevated humidity significantly promoted aspirin degradation. Similarly, Alhamdany and Alfahad (2021) emphasized the importance of monitoring the stability of commercial aspirin products under storage conditions. In addition, melting point determination is a commonly used physicochemical test for assessing the purity and thermal behavior of pharmaceutical substances. Mroso et al. (1982) demonstrated that changes in the melting characteristics of aspirin could indicate physicochemical changes associated with aspirin degradation. Therefore, measurements of moisture content and melting point may provide useful indicators for assessing physicochemical changes associated with aspirin degradation. However, limited information is available regarding the moisture content and melting behavior of commercial aspirin tablets marketed in Libya. Therefore, this study aimed to compare the moisture content and melting behavior of commercial aspirin tablet products marketed in Tobruk, Libya, and to investigate the relationship between moisture content and melting point as indicators of physicochemical changes associated with aspirin degradation.

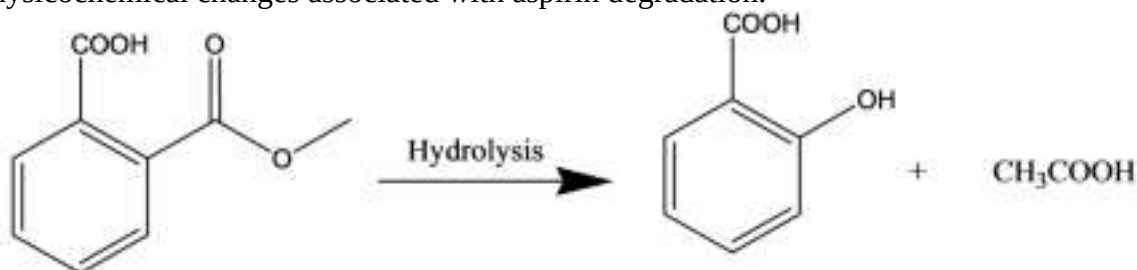


Figure 1. Hydrolysis of acetylsalicylic acid (aspirin) into salicylic acid and acetic acid

Study Significance

Due to the susceptibility of aspirin to moisture-induced hydrolysis, monitoring moisture content is important for maintaining product stability and effectiveness. In addition, melting point determination may provide useful information regarding physicochemical changes associated with degradation. Therefore, evaluating these parameters in commercial aspirin tablets marketed in Libya may contribute to quality monitoring and stability assessment

Materials and Methods

Sample Collection

Six commercially available aspirin tablet brands (75 mg) legally marketed in Libya were purchased from community pharmacies in Tobruk City in May 2026. Product information, including brand name, manufacturer, dosage strength, and expiry date, was recorded. The products were coded as I–VI for analysis (Table 1). For each brand, tablet samples obtained from the same package and batch were independently analyzed for moisture content and melting point determination. Duplicate measurements were performed for each analytical test, and the mean values were used for statistical analysis.

Melting point measurements

were carried out using a Stuart Scientific SMP3 Melting Point Apparatus (Bibby Scientific Ltd., UK) (Figure 2). For each product, tablet samples were finely powdered and introduced into capillary tubes. The tubes were placed in the instrument and heated gradually at a controlled rate of 1.0°C/min. The melting point was recorded as the temperature at which complete liquefaction of the sample occurred. The recorded values were used for comparative evaluation of the thermal characteristics of the investigated commercial aspirin tablet products.



Figure 2 Stuart Scientific SMP3 Melting Point Apparatus

Determination of Moisture Content

Moisture content was determined using a halogen moisture analyzer (Model HB43-S, Mettler Toledo, Switzerland). Tablet samples were finely powdered, and an accurately weighed 4.0 g portion of each sample was placed in the sample pan of the analyzer. The samples were dried at 105°C using the automatic end-point criterion of the moisture analyzer until constant weight was reached (Figure 3). Moisture content was automatically calculated by the instrument as the percentage loss in mass during the drying process and recorded for each sample. All measurements were performed in duplicate, and the mean values were used for data analysis.



Figure 3. moisture analyzer Model HB43-S.

Table1: Name, code, Dosage, Manufacturer and Expiration Date of aspirin Brands.

	Name	Aspirin Dosage	Brand Code	Expiry Date	Country of Manufacture
1	Domina	75mg	I	Syria	7/2027
2	Aggregex	75mg	II	Egypt	5/2028
3	Aspocid	75mg	III	Egypt	10/2027
4	Ria Generics (Dispersible)	75mg	IV	UK	2/2028
5	Ria Generics (Gastro-Resistant)	75mg	V	UK	2/2029
6	Medreich PLC	75mg	VI	UK	2/2029

Statistical Analysis

Statistical analysis was performed to evaluate the association between moisture content and melting point among the investigated aspirin tablet products. The mean values obtained from duplicate measurements were used for analysis. Pearson's correlation coefficient (r) was calculated to assess the strength and direction of the relationship between the two variables. Simple linear regression analysis was performed to evaluate the association between moisture content and melting point and to determine the coefficient of determination (R^2). Statistical significance was considered at $p < 0.05$. Statistical analyses were performed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA).

Results

The moisture content and melting point values of the six investigated aspirin tablet brands are presented in Table 2. Moisture content ranged from 0.1% to 1.4%, while melting point values ranged from 134.4°C to 136.5°C. Brand I exhibited the lowest moisture content (0.1%) and the highest melting point (136.5°C), whereas Brand VI showed the highest moisture content (1.4%) and the lowest melting point (134.4°C)

Table 2. Moisture content and melting point of commercial aspirin tablet brands.

	aspirin Brands	Melting point C°	Moisture %
1	I	136.5	0.1
2	II	136.1	0.3
3	III	135.7	0.6
4	IV	135.2	0.8

5	V	134.8	1.0
6	VI	134.4	1.4

Statistical analysis of the relationship between moisture content and melting point is presented in Table 3. Pearson correlation analysis revealed a very strong negative correlation between moisture content and melting point ($r = -0.992$, $p < 0.001$). Linear regression analysis demonstrated that moisture content explained approximately 98.3% of the variation in melting point values ($R^2 = 0.983$). The regression model was statistically significant ($p < 0.001$).

Table 3. Statistical analysis of the relationship between moisture content and melting point

Parameter	Value
Number of samples (n)	6
Pearson correlation coefficient (r)	- 0.992
Coefficient of determination (R^2)	0.983
Regression equation	MP = 136.62 – 1.67(MC)
p-value	< 0.001
Relationship strength	Very strong negative correlation

The graphical representation of the data (Figure 4) illustrates the inverse relationship between moisture content and melting point. The regression line showed a gradual decrease in melting point values with increasing moisture content. Figure 2. Linear regression analysis showing the relationship between moisture content (%) and melting point (°C) of commercial aspirin tablets marketed in Tobruk, Libya. The regression line indicates a strong negative correlation between the two variables ($R^2 = 0.983$, $r = -0.992$, $p < 0.001$). Descriptive statistical analysis showed that the mean moisture content of the investigated aspirin products was 0.70%, ranging from 0.10% to 1.40%. The mean melting point was 135.45°C, with values ranging from 134.40°C to 136.50°C (Table 4). These findings indicate measurable variability among the tested commercial products with respect to both moisture content and thermal characteristics.

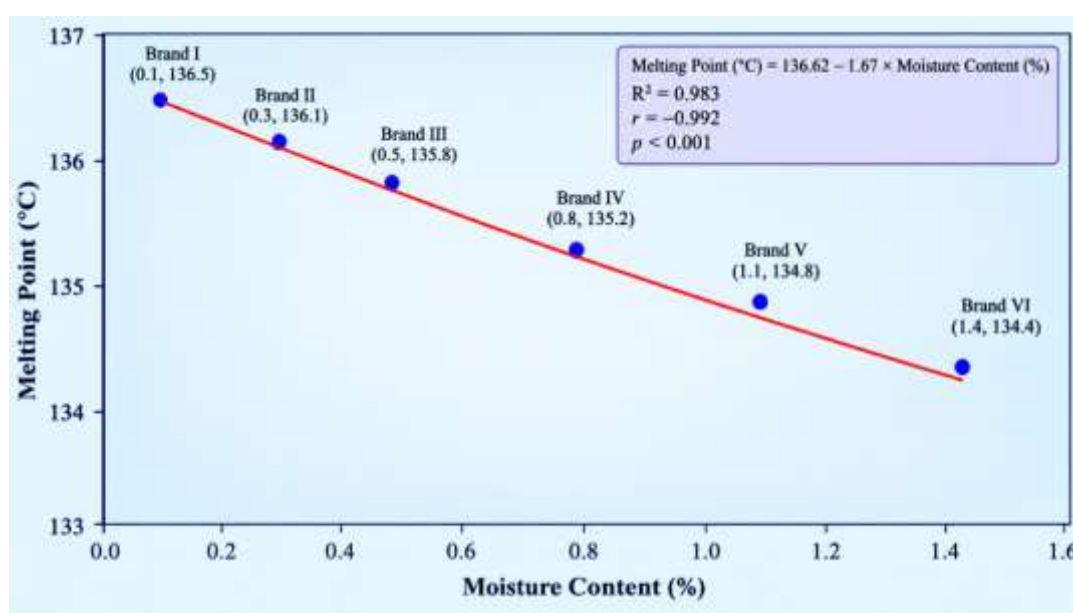


Figure 4. Linear regression analysis showing the relationship between moisture content (%) and melting point (°C) of commercial aspirin tablets marketed in Tobruk, Libya.

Table 4. Descriptive statistics of moisture content and melting point of commercial aspirin tablets

Parameter	Moisture Content (%)	Melting Point (°C)
Mean	0.70	135.45
Minimum	0.10	134.40
Maximum	1.40	136.50
Range	1.30	2.10

Discussion

The present study demonstrated an inverse relationship between moisture content and melting point among six commercially available aspirin tablet products marketed in Tobruk, Libya. As shown in Table 2 and Figure 4, products with higher moisture content generally exhibited lower melting point values. Statistical analysis further supported this observation, revealing a very strong negative correlation between moisture content and melting point ($r = -0.992$, $p < 0.001$), with moisture content explaining approximately 98.3% of the variation in melting point values ($R^2 = 0.983$) (Table 3). The observed inverse association between moisture content and melting point suggests that products with higher moisture levels tended to exhibit lower melting point values. Previous studies have reported that exposure to moisture may contribute to physicochemical changes in aspirin formulations; however, the present study did not directly evaluate hydrolysis or degradation products. Therefore, the observed relationship should be interpreted as an association rather than evidence of a causal effect. These findings are consistent with previous studies that reported increased aspirin degradation under humid storage conditions (Li et al., 2008; Husejnović et al., 2025). The observed melting point values reflected differences in the thermal characteristics of the investigated commercial tablet formulations. The results suggest that moisture content may be associated with changes in the physicochemical characteristics of aspirin tablet products during storage. Among the investigated products, Brand I showed the lowest moisture content and highest melting point, whereas Brand VI exhibited the highest moisture content and lowest melting point. These differences may be related to variations in formulation, packaging, manufacturing processes, or storage conditions. Because the correlation and regression analyses were based on only six commercial products, the findings should be interpreted with caution and confirmed in studies involving a larger number of products and batches. A limitation of the present study is the small number of products examined and the assessment of only two quality parameters. Therefore, future studies should include additional quality-control tests such as assay, dissolution, hardness, friability, and content uniformity, as well as stability studies under controlled temperature and humidity conditions to provide a more comprehensive evaluation of commercial aspirin products marketed in Libya.

Limitations

Only six products were tested and only two analytical parameters were evaluated. No assay, dissolution, degradation-product, or stability testing was performed.

Conclusion

The present study compared the moisture content and melting behavior of six commercially available aspirin tablet products marketed in Tobruk, Libya. The results revealed variations in moisture content and melting point among the investigated products. A strong inverse relationship was observed between moisture content and melting point, as confirmed by Pearson's correlation analysis ($r = -0.992$, $p < 0.001$) and linear regression analysis ($R^2 =$

0.983). Products with higher moisture content generally exhibited lower melting point values. The findings indicate an inverse association between moisture content and the thermal characteristics of the investigated commercial aspirin tablet formulations. Therefore, monitoring moisture content together with melting behavior may provide useful information for the quality assessment of commercial aspirin products. Further studies incorporating additional quality-control parameters, including assay, dissolution, hardness, friability, and content uniformity testing, as well as stability studies under controlled temperature and humidity conditions, are recommended to provide a more comprehensive evaluation of aspirin products marketed in Libya.

References

- [1] British Pharmacopoeia Commission. British Pharmacopoeia 2023. London, UK: The Stationery Office; 2023.
- [2] United States Pharmacopeial Convention. The United States Pharmacopeia 29–National Formulary 24 (USP 29–NF 24). Rockville, MD, USA: USP Convention; 2006.
- [3] Li LL, Zhan XC, Tao JL. Evaluation of the Stability of Aspirin in Solid State by the Programmed Humidifying and Non-isothermal Experiments. *Archives of Pharmacal Research*. 2008;31(3):381–389.
- [4] Chakraborty S, Banerjee R, Das P. Stability Testing of Aspirin Tablets under Different Environmental Conditions. *Journal of Pharmaceutical Research*. 2017..
- [5] Dhiman R. Effect of Temperature on the Purity and Yield of Aspirin. *International Journal of Scientific and Health Research (IJSHR)*. 2023;5(5).
- [6] Alhamdany H, Alfahad M. Stability Evaluation of Acetylsalicylic Acid in Commercial Aspirin Tablets Available in the Iraqi Market. *Journal of Advanced Pharmacy Education & Research*. 2021;11(3).
- [7] Husejnovic M, Smajic A, Talic A, Merdic A, Selimovic A, Causevic E, Kozarevic E, Husejnovic A. Stability Evaluation of Acetylsalicylic Acid in Commercial Aspirin Tablets under Different Storage Conditions. *Journal of Pharmaceutical Research International*. 2025;37(2):66–74.
- [8] Mroso PV, Li Wan Po A, Irwin WJ. Solid-State Stability of Aspirin in the Presence of Excipients: Kinetic Interpretation, Modeling, and Prediction. *Journal of Pharmaceutical Sciences*. 1982;71(10):1096–1101.
- [9] Stuart Scientific Ltd. SMP3 Melting Point Apparatus: Instruction Manual. Staffordshire, United Kingdom.
- [10] Mettler Toledo AG. Moisture Analyzer Application Methods for HB43-S. Laboratory & Weighing Technologies; 2011. Document No. 91178097.
- [11] Shirsat P, Sontakke S, Shirwale P, More S, Kolhe S. Comparative Study on Aspirin Bulk Powder (API) and Aspirin Tablets. *International Research Journal of Modernization in Engineering Technology*. 2026;8(4).
- [12] Olayemi O, Adegoke A, Ogunbona F. Comparative Evaluation of the Quality of Different Brands of Aspirin Tablets Marketed in Nigeria. *Journal of Pharmaceutical Research International*. 2021;33(35A):45–53.
- [13] John AA, Omonyemen EC, Onah I. Effect of Humidity on the Physical Properties of Aspirin Tablets Produced by Melt Granulation and Slugging Methods. *IOSR Journal of Pharmacy and Biological Sciences*. 2013;7(5):20–25.
- [14] Wang MJ. Prediction of Moisture Content of a Packaged Moisture Sensitive Pharmaceutical Product Stored under Fluctuating Temperature and Humidity Environments. Master's Thesis. Michigan State University, East Lansing, USA; 1985.
- [15] Waleed R, Fatima S. Quality Control of Aspirin: Experimental Synthesis Versus Industrial Formulations. *International Journal of Science and Engineering Applications*. 2025;14(9).
- [16] Yasmeen A, Sara G, Almontaser A, Najat F. Pharmaceutical Quality Control Testing of Different Brands of Aspirin Sold in Al-Bayda City Markets. *Alqalam Journal of Medical and Applied Sciences*. 2023;6(2):460–468.
- [17] Field A. *Discovering Statistics Using IBM SPSS Statistics*. 5th ed. Sage Publications; 2018.

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 JIBAS and/or the editor(s). JIBAS 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.