Journal of Animal & Plant Sciences, 36(3): 2026, Page: 820-830
ISSN (print): 1018-7081; ISSN (online): 2309-8694
https://doi.org/10.36899/JAPS.2026.3.0067

MORICANDIA Arvensis: A MULTIFUNCTIONAL MEDICINAL PLANT WITH BROAD BIOLOGICAL ACTIVITIES: PHYTOCHEMICAL CONTENT, POTENTIAL ANTIOXIDANTS, ANTI-HEMOLYTIC AND ANTIMITOTIC INVESTIGATION

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ABSTRACT

Moricandia arvensis is a flowering plant of the Brassicaceae family. Its richness of flavonoid glycosides, such as kaempferol and quercetin derivatives, contribute to many biological properties. This study evaluates the phytochemical composition and in vitro biological activities of ethanolic and acetonic extracts from *Moricandia arvensis* leaves and flowers. Phytochemical screening revealed the presence of tannins, terpenoids, alkaloids, sterols, reducing compounds, and starch, highlighting the chemical richness of this species. Antioxidant activity assessed by the DPPH scavenging assay demonstrated that the acetonic flower extract exhibited the highest activity (IC_{50} = 6.44 ± 0.89 mg/mL), which was 21% to 89 % higher compared to other extracts, respectively; however, it remained considerably weaker than the standard antioxidant ascorbic acid (IC_{50} = 1.67 ± 0.051 mg/mL). Anti-hemolytic analysis indicated that the ethanolic flower extract increased erythrocyte membrane protection by approximately 30% relative to the acetonic extract, achieving up to 60% protection at 0.5 mg/mL. The Allium cepa mitotic model revealed that the acetonic leaf extract reduced the mitotic index by around 65% compared to the untreated control and marginally exceeded colchicine (60%) in mitotic inhibition. Notably, the prophase arrest induced by the extract contrasted with colchicine's metaphase arrest, suggesting a distinct cytological mechanism. Overall, *M. arvensis* exhibited moderate anti-hemolytic and pronounced antimitotic effects, but antioxidant capacity was relatively weak. These quantitative findings contribute valuable insights into the biological properties of *M. arvensis* extracts and provide a foundation for future studies focused on bioactive compound isolation and further pharmacological investigation.

Keywords: *Moricandia arvensis,* DPPH scavenging, *Allium cepa* assay, anti-hemolytic activity.

Published first online February 14, 2026 Published final May 05, 2026

INTRODUCTION

The medicinal use of plants spans human history, with archaeological evidence confirming that prehistoric societies utilized botanical resources to treat various ailments (Petrovska, 2012). The Brassicaceae family, which includes many widely used species, is distinguished by its rich diversity of secondary metabolites, notably glucosinolates, phenolic acids, flavonoids, and isothiocyanates, that confer diverse biological activities (Braham *et al.*, 2005; Marrelli *et al.*, 2018; Hardy, 2021).

Within Brassicaceae, the genus Moricandia comprises eight species distributed across Mediterranean regions, many of which demonstrate intermediate C_3-C_4 photosynthetic metabolism (Perfectti *et al.*, 2017; Triesch *et al.*, 2025). *Moricandia arvensis*, a purple-flowering biennial herb, is traditionally used for food and medicine, with preliminary reports highlighting its bioactive compounds and potential health benefits (Farooq Khan *et al.*, 2021; Aly *et al.*, 2023; Aly *et al.*, 2024).

The plant's methanolic extract and its sub-extracts (dichloromethane and ethyl acetate) have demonstrated strong inhibitory activity against pancreatic lipase, an enzyme crucial for lipid absorption, suggesting potential use in managing obesity. Additionally, these extracts show significant antioxidant activity by scavenging free radicals and protecting lipids from peroxidation (Marrelli *et al.*, 2018). The plant also exhibits protective effects against DNA damage and displays anticancer properties, including promoting

antiproliferation and apoptosis in human cancer cells (Skandrani *et al.*, 2010). Essential oils from *Moricandia arvensis* have antimicrobial activity as well (Zeraib *et al.*, 2011).

Despite these findings, limited research has addressed the comprehensive phytochemical composition and pharmacological properties of *M. arvensis* aerial extracts, particularly from arid environments. The specific gap lies in understanding the comparative phytochemistry and biological activities, including antioxidant, anti-hemolytic, and antiproliferative effects of ethanolic and acetonic extracts from leaves and flowers collected in the South Algerian Sahara.

This study aims to provide the first systematic characterization of these extracts and to evaluate their biological relevance, thereby addressing an important gap in the knowledge of *M. arvensis* and extending the pharmacological potential of Brassicaceae species.

MATERIALS AND METHODS

Plant material: *M. arvensis* (Figure 1) was harvested in March 2024 from its natural habitat (Bechar, Algeria). Then the plant was air-dried in the dark at room temperature for 15 days. Leaves and flowers were selected and ground separately to obtain a fine powder. This latter was stored at 4°C for further use. A reference voucher specimen (CA02/32) is archived in the Phytochemistry and Organic Synthesis Laboratory herbarium, University of Tahri Mohammed Bechar, Algeria.

Fig. 1. *Moricandia arvensis* photographed in its native habitat, the South Algerian Sahara

Extracts preparation and phytochemical screening: Extracts were prepared using solvents at different polarities: petroleum ether, methanol, and distilled water to carry out a series of qualitative phytochemical screening tests.

Etheric, methanolic and aqueous: Twenty grams of leaf or flower powder were macerated in 60 mL of petroleum ether with continuous stirring for 30 min, followed by filtration through Whatman filter paper. This process was

repeated twice, and the combined filtrates were concentrated under reduced pressure using a rotary evaporator and stored for further use. The resulting marc was then extracted twice with 60 mL of methanol under the same stirring and filtration conditions. The methanolic filtrates were combined and concentrated under reduced pressure for subsequent analyses. Furthermore, the aqueous extract was prepared by refluxing 20 *g* of plant powder in 150 mL of distilled water, followed by filtration and concentration to dryness to yield a dry residue (Belyagoubi *et al.*, 2016).

Phytochemical screening: The tests were done by following standard procedures. Emodols, coumarins, sterols or triterpenes, fatty acids, and alkaloids (bases and salts) were determined as described by (Nemlin and Brunel, 1995). However, the presence of terpenoids quinones, tannins and starch were also revealed (El-Haoud *et al.*, 2018; Sharma *et al.*, 2020). The phytochemical screening of reducing compounds (Okwu and Omodamiro, 2005), flavonoids (El Hariri *et al.*, 1991), saponins (Sharma *et al.*, 2020) was tested in different extracts.

Preparation of ethanolic and acetone extracts: Ethanolic and acetonic extracts were prepared by macerating 20 *g* of dried, powdered plant material (leaves or flowers) in 200 mL of 96% ethanol or acetone for 24 h at room temperature. The mixtures were filtered, and the solvents were evaporated under reduced pressure to obtain dry residues (Lezoul *et al.*, 2020).

DPPH radical scavenging of different extracts: Antioxidant activity evaluation of *M. arvensis* (leaves and flowers) was carried out in vitro by measuring the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging capacity. Briefly, a 0.750 mL of each extract at different concentrations ranging from 0 to 50 mg/mL (methanol for the control) was placed in a test tube, and 1.5 mL of a DPPH methanolic solution (20 g/L) was added. The absorbance was measured at 517 nm after 20 min of incubation. This measure was carried out in triplicate (Parejo *et al.*, 2002).

The inhibitory concentrations (IC_{50}) were calculated using the following formula:

$$\text{DPPH inhibition (\%)} = \left[\frac{(Ac - At)}{Ac}\right] x100$$

Ac: absorption of control; At: absorption of test.

For each extract, IC_{50} was determined, which is the substrate concentration that causes the loss of 50% of DPPH activity (Samarth *et al.*, 2008). IC_{50} was graphically calculated by linear regressions of plotted graphs.

Anti-hemolytic activity

Human red Blood Cell preparation: Human red blood cells (RBC) were freshly collected in heparinized tubes from a healthy volunteer who had not taken any anti-inflammatory drugs in the 48 h prior to collection. After that, a haematocrit of 10% was prepared from an iso-saline PBS solution after two successive iso-saline PBS washing (Moreira *et al.*, 2011). This study was conducted in accordance with Algerian law 25/2006 (Resolution No. 387). Written informed consent was obtained from the donor, and the research protocol received approval from the Ethics Committee at the University of Tlemcen.

In vitro Anti-hemolysis effect of Moricandia arvensis: The anti-hemolytic effect of plant extracts was carried out in vitro using a human erythrocyte model, prepared before. Briefly, mixture of 100 µL of each *M. arvensis* extract at different concentrations (0.1, 0.2, 0.3, 0.4, 0.5) was prepared with 100 µL of the erythrocyte suspension (10%); after incubation at room temperature for 10 min, 4 mL of NaCl at 4.5 mg/mL concentration was added. The mixture was left to incubate at 37°C for 30 min and then centrifuged at 3000 *rpm* for 10 min. The absorbance of the supernatant was read at 540 nm. This measure was carried out in triplicate (Moreira *et al.*, 2011).

The hemolysis rate was calculated using the following formula:

$$\text{Hemolysis (\%)} = \left[\frac{At}{Ac}\right] x100$$

At: absorption of test; Ac: absorption of control.

Antimitotic activity: A modified method described by (Barman *et al.*, 2021) was used to assess the antimitotic activity of ethanolic and acetonic extracts using *the Allium cepa* roots assay. Onion bulb roots were grown back in water for a few days (3 to 5 days) at room temperature. Bulbs that developed a uniform root were selected for study. After that, selected onion bulb roots (3 onions per studied concentration) were exposed to each concentration of *M. arvensis* (0.5, 0.25, 0.125 mg/mL) extracts for 24 h at room temperature. A positive control (colchicine 1 mg/mL) and a negative control (distilled water) were also prepared (3 onions for each control). After 24 h of incubation, root tip cells of each onion were fixed with Carnoy's liquid for 30 minutes or more, hydrolysed with 1 N HCl, then stained with Giemsa stain for 20 minutes. Finally, prepared slides (Three slides per onion) were observed under a light microscope (×400) to determine the number of dividing cells and calculate the mitotic index (MI) and phase index (PI) for each extract.

The mitotic index was calculated according to the following formula:

$$\text{MI (\%)} = \left[\frac{\text{Number of divided cells}}{\text{Total cell number}}\right] x100$$

The phase index was calculated according to the following formula:

$$\text{PI (\%)} = \left[\frac{\text{Number of cells in specific phase (P,M,A,T)}}{\text{Total divided cells (P+M+A+T)}}\right] x100$$

With:

P: Prophase; M: Metaphase; A: Anaphase; T: Telophase.

Statistical analysis: In order to assess differences between groups yield, antioxidant and anti-hemolytic

activities, the measures were carried out in triplicates. Data were expressed as mean values ± SEM. However, antimitotic activity was carried out on 500 total counted cells from three slides of each tested doses. Statistical significance was evaluated using one-way analysis of variance (ANOVA) followed by Tukey's post hoc test (GraphPad, Prism 8.0) for means comparison at $p \leq 0.05$.

RESULTS

Phytochemical screening of *Moricandia arvensis*: Phytochemical screening was carried out on extracts prepared from the aerial part (leaves and flowers) of *M. arvensis*. The results are summarized in the table below:

Table 1: Qualitative analysis of major phytochemical classes in etheric, methanolic, and aqueous extracts of *Moricandia arvensis* aerial parts.

Extract	Etheric extract		Methanolic extract		Aqueous extract	
Plant part	**Leaves**	**Flowers**	**Leaves**	**Flowers**	**Leaves**	**Flowers**
Emodols	-	-	/	/	/	/
Alkaloids bases	-	+	/	/	/	/
Sterols or triterpenes	+	+	/	/	/	/
Coumarins	-	+	/	/	/	/
Terpenoids	+	+	/	/	/	/
Free Quinones	+	-	/	/	/	/
Fatty acids	-	-	/	/	/	/
Alkaloids salts	/	/	/	/	+	+
Tannins	/	/	-	+	-	+
Reduced compounds	/	/	-	+	-	-
Flavonoïds	/	/	-	-	/	/
Heterosides sterolic or triterpenes	/	/	-	-	/	/
Saponins	/	/	/	/	+	-
Starch	/	/	/	/	-	+

(+): Positive test; **(-):** Negative test.

The results showed the presence of alkaloids, sterols, coumarins, and terpenoids in the etheric extract of flowers. On the other hand, only sterols, free quinones, and terpenoids were found in the etheric extract of the leaves. However, tannins and reducing compounds were revealed in the methanolic extract of flowers.

Yield of dry extracts of *Moricandia arvensis:* Figure 2 compares the yield extraction efficiency of different solvents (ethanol and acetone) applied to leaves and flowers of *M. arvensis*. According to these results, acetonic flower extract presented the best yield extraction of *M. arvensis* in comparison with other extracts. Results revealed that acetonic flower extract presents the best yield compared with other extracts.

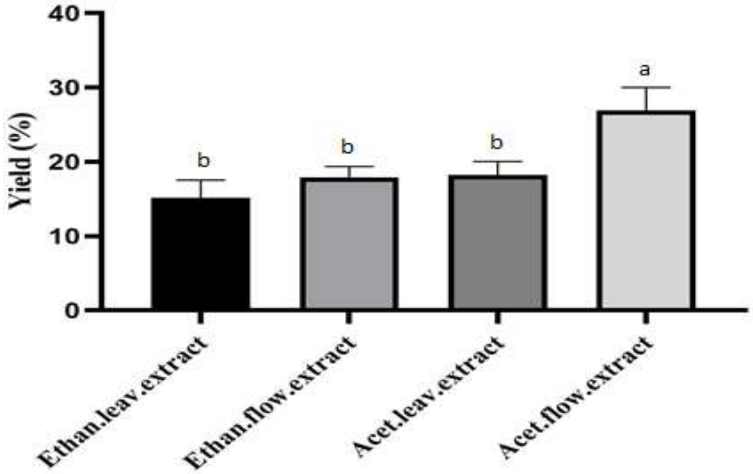

Fig. 2. Extraction yield (%) of *M. arvensis* leaf and flower ethanol and acetone extracts. Values are mean ± SEM (n = 3). Different letters indicate significant differences (p < 0.05).

Antioxidant activity of *Moricandia arvensis:* The plant extracts generally show lower inhibition at very low concentrations compared to ascorbic acid, but their maximal inhibition at higher concentrations (above 10 mg/mL) appears similar to or slightly higher than ascorbic acid, generally ranging from about 55% to 65%. Among the extracts, the leaves acetonic extract and the flowers acetonic extract appear to have the highest maximum inhibition (around 65% for the leaves and slightly above 60% for the flowers). In contrast, the leaves ethanolic extract seems to show the lowest DPPH inhibition among the extracts (around 58%, IC_{50} =12 mg/mL), indicating it is the least effective antioxidant among the tested extracts. The antioxidant activity of the extracts showed relatively weak free radical scavenging compared to ascorbic acid. However, the acetonic flower extract demonstrating the best activity among tested samples (IC_{50} = 6.44 ± 0.891 mg/mL vs. 1.67 ± 0.052 mg/mL for ascorbic acid).

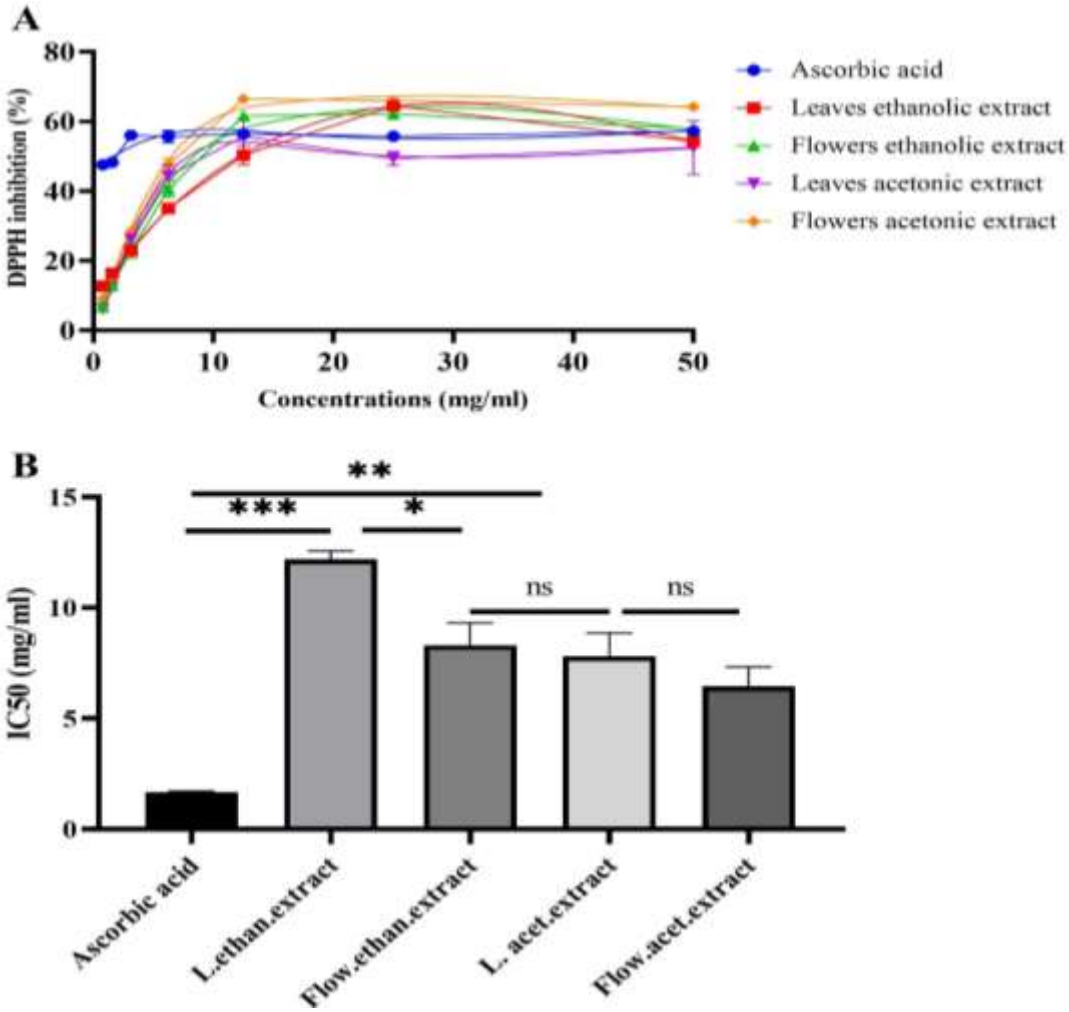

Fig. 3. (A) DPPH radical scavenging activity (%) of *Moricandia arvensis* leaf and flower extracts (ethanolic and acetonic) at different concentrations, compared to ascorbic acid (positive control). (B) IC_{50} values of extracts and positive control. $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, ns: not significant.

Anti-hemolytic activity: The protection against hemolysis activity of *M. arvensis* extracts was depicted in figure 4. Results demonstrate their potential to protect erythrocytes from oxidative damage-induced hemolysis. This property is crucial for applications in preventing hemolytic disorders and oxidative stress-related diseases. This study demonstrates that *M. arvensis* flower ethanolic extract exhibited significantly superior anti-hemolytic activity compared to acetonic extract ($p< 0.001$), with protection values of 55-60% versus 42-52%, respectively, across tested concentrations (0.05-0.5 mg/mL). In parallel, the ethanolic extracts showed concentration-dependent protective effects ($p < 0.01$) against hypotonic hemolysis induced erythrocyte membrane damage and achieved maximum protection at 0.5 mg/mL concentration.

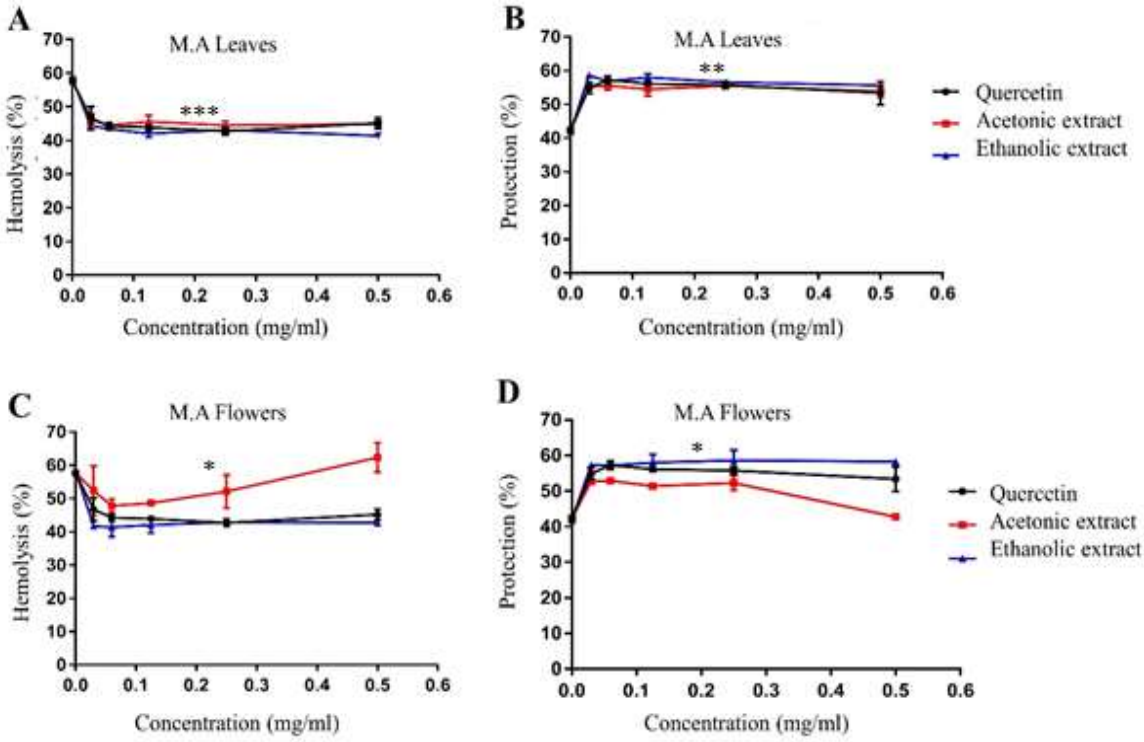

Fig. 4. Anti-hemolytic activity of *Moricandia arvensis* ethanolic and acetonic extracts at increasing concentrations and quercetin (positive control): (A) Hemolytic activity of leaf extracts, (B) Protective activity of leaf extracts, (C) Hemolytic activity of flower extracts, (D) Protective activity of flower extracts. Data represent the mean ± SEM of triplicate experiments. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Antimitotic activity of *Moricandia arvensis*: The data revealed variations in the mitotic index (MI %) and phase index between different concentrations of ethanolic and acetonic extracts from *M. arvensis* leaves and flowers. These variations reflect the influence of bioactive compounds in the extracts on the cell cycle and mitotic progression.

Table 2: Mitotic index and phase index determination of onion root cells treated with the different extracts of *M. arvensis*.

Extracts **	Concentrations (mg/mL)	MI (%)	PI (%)			
			P	M	A	T
Ethanolic Leaf extract	0.125	2.77*#	2.22*#	0.176#	0.37	--
	0.25	0.968*#	1.68*	0.239#	0.48	--
	0.5	0.660 #	0.662#	--	--	--
Acetonic Leaf extract	0.125	0.819*#	0.661#	0.163#	--	--
	0.25	0.881*#	0.663#	0.224#	--	--
	0.5	32.5*#	32.1*#	0.423#	--	--
Ethanolic Flower extract	0.125	3.38*#	0.718*#	0.482#	1.20	0.961
	0.25	1.57*#	1.18*#	0.391#	--	--
	0.5	0.381#	0.392	--	--	--
Acetonic Flower extract	0.125	6.19*#	6.19*#	--	--	--
	0.25	1.18*#	1.18*#	--	--	--
	0.5	1.17*#	0.973*#	--	--	0.193
Negative control	0	0.392	0.392	--	--	--
Positive control (Colchicine)	1	4.58	1.71	2.86	--	--

**The onion root cells of each of the three slides per concentration were counted. Mitotic index (MI) was calculated from total cell numbers equal to 500 counted cells obtained from the three slides, and phase index (PI) was calculated from only total divided cells. (P): Prophase; (M): Metaphase; (A): Anaphase, (T): Telophase. *$p \leq 0.05$ values are statistically significantly than negative control. #$p \leq 0.05$ values are statistically significant than positive control.

The acetonic leaf extract at 0.5 mg/mL significantly reduced the mitotic index in onion root cells (MI = 32.55%), comparable to colchicine-treated controls (MI ~33%). However, while colchicine predominantly arrests cells at metaphase, the extract caused substantial prophase accumulation (32.13%), suggesting a distinct mechanism of mitotic disruption that impedes progression prior to metaphase.

In parallel, increasing concentrations generally correlated with decreased mitotic activity, indicating dose-dependent cytotoxicity or mitotic arrest effects (MI from 2.77% at 0.125 mg/mL to 0.660% at 0.5 mg/mL).

Furthermore, ethanolic flower extract, particularly at 0.125 mg/mL, caused higher mitotic inhibition (MI = 3.38%) and a notable increase in anaphase and telophase indexes compared to leaves, which may indicate differential compound profiles in flower tissues affecting cell cycle regulation differently. The plant extracts mimic similar but not identical colchicine effects (MI = 4.58%, M = 2.86%) according to negative control.

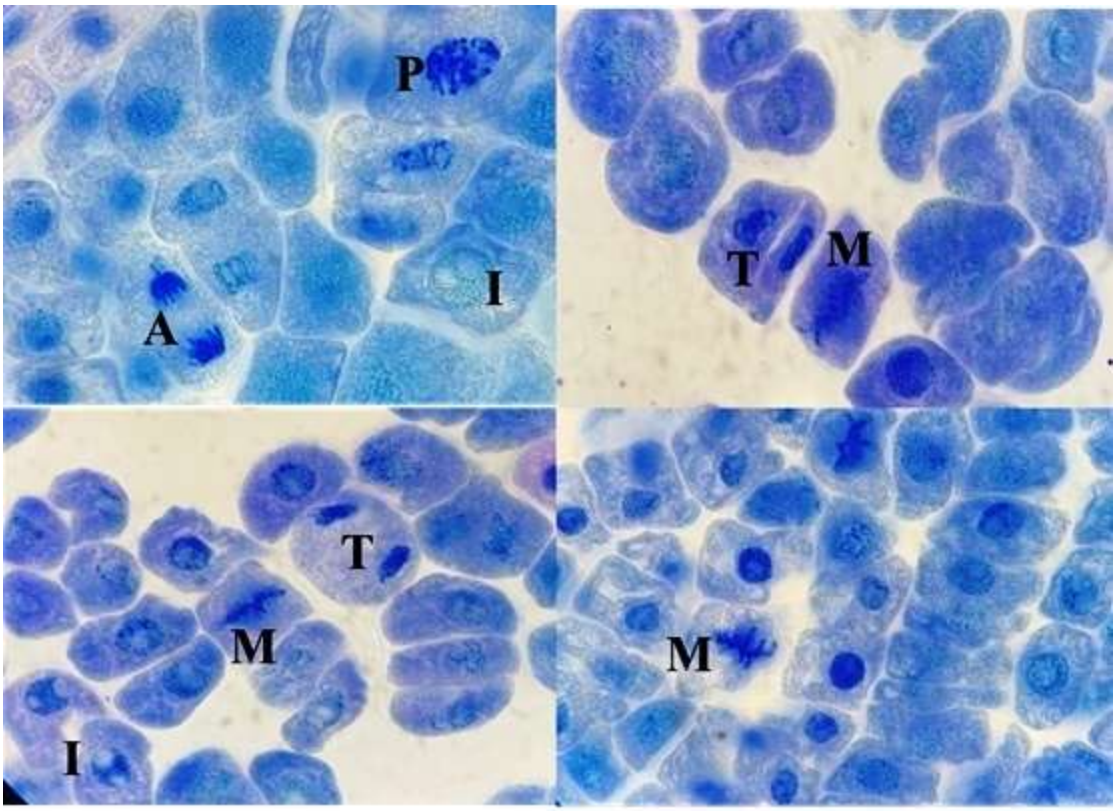

Fig. 5. The effect of *M. arvensis* leaves and flowers on meristematic cells of Allium cepa roots (regular and normal division). I: Interphase, P: Prophase, M: Metaphase, A: Anaphase, T: Telophase. Giemsa stain 400X.

DISCUSSION

Phytochemical tests carried out on the aerial part (leaves and flowers) of *M. arvensis* show it to be remarkably rich in secondary metabolites, giving it various therapeutic properties. According to Marrelli and coworkers, the leaves of *M. arvensis* were used in traditional cooking, and a decoction of the leaves and stems was used in the treatment of syphilis and scorbut (Marrelli *et al.*, 2018). Berreghioua (2018) added that the presence of steroids in the leaves of *M. arvensis* explains its use to soothe pain caused by headaches or rheumatism. On the other hand, the presence of tannins justifies the use of *Zilla macroptera*, which belongs to the Brassicaceae family, for gastric disorders and stomach pains. According to the following results, the flowers of *M. arvensis* are also rich in tannins (Berreghioua and Cheriti, 2018). In fact, the components identified in this study characterizes almost all Brasicaceae. The study conducted on the phytochemical *M.arvensis* shows that this species contains phenolics glycosides, indoles, derivatives of glucosinolates and the fatty acids. Glucosinolates are compounds containing sulphur and nitrogen, they characterizes the Brassicaceae and neighbouring families of Caparales order (Zeraib *et al.*, 2011). According to the literature, saponins are very common in medicinal plants but are rarely found in the Brassicaceae family (Hussain *et al.*, 2019).

The extraction yield of plant materials is a critical factor in determining their potential for pharmacological and nutraceutical applications. Results established that the best extraction yield of *M. arvensis* was observed in acetonic flower extract in comparison with other extracts. In fact, acetone, being moderately polar, efficiently extracts a broader range of phytochemicals, including glucosinolates and terpenoids, leading to higher yields (Quitério *et al.*, 2022). On the other hand, the higher yield in acetone extracts suggests its suitability for obtaining bioactive compounds for antioxidant and anti-inflammatory studies (Marrelli *et al.*, 2018).

This study revealed that among extracts, acetonic flower extract indicated the best activity between tested samples (IC_{50} = 6.44 ± 0.893 mg/mL vs. 1.67 ± 0.05 mg/mL for ascorbic acid). In addition, it is well known that the extraction solvent plays a role; the acetonic extracts (leaves and flowers) generally show better activity (lower IC_{50}) compared to the ethanolic extracts. Furthermore, the plant part matters, as the flower's acetonic extract is the most effective among the extracts, suggesting its compounds are more potent DPPH scavengers or are better extracted by acetone. This aligns with previous reports on *Moricandia arvensis*, which highlight moderate antioxidant potential attributed to its phenolic and flavonoid content (Skandrani *et al.*, 2010). While related Brassicaceae species have demonstrated stronger antioxidant activities due to glucosinolates and their breakdown products (Braham *et al.*, 2005), the present findings suggest a more modest effect, emphasizing the need to interpret the pharmacological potential with caution. Supporting studies reported potent antioxidant activity in related Moricandia species with substantially lower IC_{50} values (Aly *et al.*, 2024), indicating possible variation due to extraction methods, plant parts, or environmental factors. Therefore, although the extracts show some antioxidant properties, further research is needed to fully elucidate their pharmacological relevance and limitations (Marrelli *et al.*, 2018). These differences highlight the importance of selecting the appropriate solvent and plant part for maximizing the extraction of bioactive antioxidant compounds.

Furthermore, the protection effects against hemolysis of *M. arvensis* extracts were evaluated. This property is critical for applications in preventing hemolytic disorders and oxidative stress-related diseases. It was established that the primary mechanism for the anti-hemolytic activity of plant extracts is linked to their antioxidant capacity (as measured previously through DPPH assay). Red blood cells are highly susceptible to damage by Reactive Oxygen Species (ROS), such as hydroxyl radicals (·OH) and hydrogen peroxide (H_2O_2). The rich content of polyunsaturated fatty acids in the RBC membrane and the presence of iron-rich hemoglobin make them particularly vulnerable to oxidative stress (Khalili *et al.*, 2014; Meziti *et al.*, 2019).

The following study demonstrated that *M. arvensis* flower ethanolic extract exhibited significantly high anti-hemolytic activity compared to acetonic extract ($p< 0.001$), with protection rate of 55-60% versus 42-52%, respectively, across tested concentrations (0.05-0.5 mg/mL). This observation revealed significant differences between extraction solvents, with ethanol yielding compounds through enhanced membrane-stabilizing properties. These protective effects were attributed to the extracts' capacity to inhibit lipid peroxidation and scavenge reactive oxygen species, mechanisms that prevented oxidative membrane damage and maintained erythrocyte integrity (Pisoschi *et al.*, 2021), The superior performance of ethanolic extracts aligned with previous findings in Brassicaceae species, where polar solvents preferentially extracted phenolic compounds responsible for antioxidant and membrane-protective activities (Yuan *et al.*, 2024).

The Allium cepa assay, commonly known as the onion root tip assay, is a widely used and reliable bioassay for screening the antimitotic (cell division inhibiting), cytotoxic, and genotoxic activities of various substances, including plant extracts (Sandeep *et al.*, 2020).

In the highlight of these results, most extracts demonstrated concentration-dependent effects. Flower acetonic extract at 0.125 mg/mL showed significantly high MI = 6.19%, exceeding colchicine. However, leaf acetonic extract at 0.5 mg/mL showed extreme elevation (MI = 32.5%), indicating severe mitotic disruption. The minimal presence of other phases further reflects potent inhibition of mitotic progression, though the phase distribution highlighting prophase arrest distinguishes its action from standard spindle poisons like colchicine (Ouzid *et al.*, 2023). Furthermore, data reports that plant extracts can significantly inhibit the mitotic index in *Allium cepa* root meristem cells, indicating interference with cell division. A study on methanolic leaf extracts of *Peganum harmala* demonstrated a dose-dependent decrease in mitotic index of extracts blocking mitosis predominantly at prophase, causing chromosomal abnormalities like agglutinations and binuclear cells (Ouzid *et al.*, 2023). Such mitotic arrest is a common mechanism exploited in cancer therapy, highlighting the therapeutic potential of this extract (Skandrani *et al.*, 2010). In parallel, increasing concentrations generally correlated with decreased mitotic activity, indicating dose-dependent cytotoxicity or mitotic arrest effects (MI from 2.77% at 0.125 mg/mL to 0.661% at 0.5 mg/mL).

A recent study found that aqueous leaf extract of *Maesa macrophylla* had reduced mitotic index along with mitotic abnormalities such as sticky chromosomes and anaphase bridges in Allium cepa root tips through concentration and time-dependent effects, confirming

cytotoxic and mitostatic properties (Barman and Ray, 2022). The differential sensitivity of mitotic phases, particularly the prophase and metaphase, suggests selective targeting of spindle apparatus components. Additionally, ethanolic flower extract, especially at 0.125 mg/mL, showed a significant increase in anaphase and telophase indexes and higher mitotic inhibition (MI = 3.38%) when compared to leaves. These findings may suggest that different compound profiles in flower tissues have distinct effects on cell cycle regulation. Similar but distinct effects of colchicine are mimicked by the plant extracts (MI = 4.58%, M = 2.86%). In order to explain these findings, it was reported that the Brassicaceae family primarily provides two sources of organosulfur compounds: those derived from the S-methyl cysteine sulphoxide and glucosinolate-myrosinase system (Fusari *et al.*, 2020). These compounds lead to the formation of various sulfur-containing volatile metabolites, particularly isothiocyanate (ITC). This latter was admitted to lower the incidences of different cancers (Dinkova-Kostova and Kostov, 2012; Ngo and Williams, 2021). Numerous mechanisms of preventive properties of ITC against cancer were proposed, such as mitostatic effect and apoptosis, inhibition of metastasis, angiogenesis, and changes in histone acetylation status, as well as immunomodulatory, anti-inflammatory, and antioxidant activities (Dinkova-Kostova and Kostov, 2012; Camargo and Manucha, 2017; Fusari *et al.*, 2020).

Conclusion: *Moricandia arvensis* exhibits a diverse phytochemical profile, with leaves and flowers containing numerous bioactive compounds such as alkaloids, sterols, terpenoids, tannins, and rare saponins. The acetonic leaf extract demonstrated significant antimitotic activity, characterized by prophase arrest, suggesting potential anticarcinogenic properties. Flower extracts showed moderate anti-hemolytic activity and weak antioxidant capacity, with the latter being substantially lower than standard antioxidants. These findings underscore the therapeutic promise of *M. arvensis* extracts; however, the weak antioxidant activity and lack of in vivo or clinical validation represent major limitations. Future research should prioritize isolation and detailed characterization of bioactive constituents, along with rigorous in vivo and clinical studies to confirm efficacy and safety, thus providing a clearer understanding of the pharmacological potential of *M. arvensis*.

Acknowledgment: Authors would like to thank The General Directorate of Scientific Research and Technological Development (DGRSDT) for financial support.

Conflict of Interest: None.

Source of Funding: None.

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