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Functional Properties and Acceptability of Potentially Medicinal Tea Infusions Based on *Equisetum arvense*, *Desmodium molliculum*, and *Mentha piperita*

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ABSTRACT: Natural herbal teas are one of the three most consumed beverages in the world, and despite their frequent use in the cosmetic, food, and pharmaceutical industries, there is still much to about them. This study aimed to determine the functional properties of tea infusions made from dried *Equisetum arvense* (EA), *Desmodium molliculum* (DM), and *Mentha piperita* (M) grown in the Peruvian Andes. Next, using a simplex design with unrestricted centroid amplified centroid, 12 combinations were obtained for the combination of dried leaves with EA: 0～100%, DM: 0～100%, and M: 0～100% optimal combination of EA: 6.59%, DM: 84.62%, and M: 8.79% maximizes functional components for total polyphenols (2,831.18 mg EAG/100 g), flavonoids (37.73 mg CAT/g), and antioxidant capacity (145.99 μmol Trolox/g). It can be confirmed that dried mixtures of these plants made into tea are a significant source of bioactive molecules, have a tolerable flavor, and can be used for therapeutic purposes when consumed.

Keywords: antioxidants, *Desmodium molliculum*, *Equisetum arvense*, *Mentha piperita*, polyphenols

INTRODUCTION

Concerns about the potential adverse effects of consuming beverages with excessive amounts of sugar, caffeine, and alcohol, the emergence of new infectious diseases and resistance to conventional clinical antibiotics have prompted health-conscious individuals to turn to herbal teas as therapeutic alternatives (Manteiga et al., 1997; Ríos and Recio, 2005; Perumalla and Hettiarachchy, 2011). The infusion of medicinal plants in the form of tea is widely consumed by people of all ages and social strata, with daily global consumption of approximately three billion cups (Hicks, 2009; Cozma et al., 2021; Pan et al., 2022).

Various neurodegenerative diseases, cardiovascular diseases, diabetes, obesity, and essentially any pathology involving oxidative stress have been linked to the beneficial effects of herbal teas commonly referred to as "medicinal" (Higdon and Frei, 2003; Balick and Cox, 2020; Chopra and Dhingra, 2021). This protection is likely due to the presence of numerous bioactive compounds in the plants to be infused, such as polyphenols, which constitute a vast group of substances with different chemical and biological properties, including more than 8,000 antioxidant compounds that protect cells from the risk of many free radical-induced degenerative diseases (Scalbert et al., 2005; Vuong, 2014; Ashraf, 2020; Stéphane et al., 2021; Bouyahya et al., 2022), as well as flavonoids, which in addition to their proven antioxidant capacity are attributed several curative effects, such as anti-inflammatory, cardiotonic, antineoplastic, hepatoprotective, antimicrobial, etc. activity (Narayana et al., 2001; Martínez-Flórez et al., 2002; Ferraz et al., 2020) and even as a flavor enhancer (Zeb, 2020). Furthermore, it has been shown that the sensory quality of an infusion is primarily attributable to volatile compounds, which contribute to the aroma, and nonvolatile compounds, which contribute to the flavor (Scharbert and Hofmann, 2005; Pan et al., 2022). Consequently, it is essential to investigate the antioxidant capacity, polyphenols, and flavonoids of medicinal plants infused in tea.

The Andean-Amazon region is home to a plethora of

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medicinal plant species, and Peru's multiculturalism has a long tradition of infusing healthy plant structures (leaves, roots, stems, flowers, or fruits) to extract a significant portion of their therapeutic properties. This presents a challenge to investigate the mechanisms of action, bioavailability, pharmacokinetics, active ingredients, and industrialization of products in the metabolites of potentially medicinal plants to add curative, preventative, and innovative effects against various mild and/or chronic diseases (Rojas et al., 2003; Gordillo et al., 2019).

One of them is the species *Equisetum arvense*, commonly called "horsetail," a widely used for its antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and other benefits (Al-Snafi, 2017), as well as its cytotoxic and antigenotoxic effects by activating antioxidant transcription in the promoter regions of genes that induce oxidative stress, limiting cancerous proliferation (Batir-Marin et al., 2021; Dormousoglou et al., 2022), with diuretic, antiprostatic, and renal properties thanks to flavonoids and potassium salts, which also confer demineralizing properties and contribute to the maintenance of collagen by increasing tissue elasticity (Batir-Marin et al., 2021; Boeing et al., 2021). *Desmodium molliculum* also known as "dog's paw" or "Manayupa," is an intriguing plant with multifunctional properties very similar to those of *E. arvense*, as demonstrated by studies demonstrating its high healing capacity, antiasthmatic, anti-inflammatory, antibacterial, contraceptive, antioxidant, and hepatoprotective, effects, associated with alleviating fevers, relieving inflammation, and other diseases (Boeing et al., 2021), associated with alleviating fevers, dysentery, liver diseases, wound healing, ulcers, eye diseases, abdominal tumors, asthma, nasal polyps, menstrual disorders, colds, and kidney problems, among many others (Ayala-Mata et al., 2020; Olascuaga-Castillo et al., 2020; Joshi et al., 2023). A highly appreciated species is *Mentha piperita*, commonly known as "peppermint," a species that has been shown to have good ferrous ion chelating capacity (Chan et al., 2010) and to be widely used as a folk remedy to treat irritable bowel syndrome, indigestion, flatulence, nausea, vomiting, diarrhea, and bronchopulmonary problems, due to the phenolic constituents in its leaves, thanks to the leaves, thanks to the phenolic compounds in the phenolic compounds in the leaves such as rosmarinic acid and various flavonoids, such as eriocitrin, luteolin, and hesperidin that trigger these effects, as well as its energetic aroma and refreshing taste used for pharmacological and food industries (McKay and Blumberg, 2006; Salehi et al., 2018; Mahendran and Rahman, 2020).

Notably, more than 80% of the world's population uses approximately 20,000 plants, including the aforementioned plants, for medicinal purposes in their diet (Dhakad et al., 2019; Mahendran and Rahman, 2020). Therefore, to deepen these spectra, the objective was set to determine the functionality of tea infusions based on blends of *E. arvense*, *D. molliculum*, and *M. piperita*.

MATERIALS AND METHODS

Raw material analysis

In this study, fresh *E. arvense*, *D. molliculum*, and *M. piperita* from the Iraca Chica, Chota Province, Andean region of Cajamarca in Peru were used as raw materials (Fig. 1).

The plants were taken to the National Autonomous University of Chota, where they were washed and soaked in a 3% Clorox bleach solution for approximately 40 min, then rinsed with running water and placed in a oven at a temperature of 65°C until they reached a humidity of approximately 6%. The dehydrated plants were then analyzed for pH (potentiometric method 947.05 AOAC) and moisture (%) (gravimetric method 950.46 AOAC).

Obtaining the aqueous tea extract

Table 1 shows the constituent forms of each mixture per % in g of dried plant. For this purpose, 5 g of each mixture was mixed with 200 mL of distilled water and placed in a covered container and heated to a temperature of 90°C for 5 min while the evaporated water was replaced to maintain the dilution. The extract was then filtered and centrifuged at 2,268 *g* for 5 min. Additionally, it was used to determine the content of total polyphenols, flavonoids, and antioxidant activity, diluted according to the analysis to be performed; the appropriate dilution was determined by preliminary tests (Pastoriza et al., 2017).

Determination of the total phenolic content in the aqueous extract

A modified method by Ordoñez-Gómez et al. (2018) was used to determine the total polyphenol content. Diluted tea extract (100 μL) was used, with 500 μL of Folin-

Fig. 1. Fields where raw materials are grown.

Table 1. Combinations of dried plants *Equisetum arvense*, *Desmodium molliculum*, and *Mentha piperita* for tea preparation

Mixture	*E. arvense* (%)	*D. molliculum* (%)	*M. piperita* (%)	*E. arvense* (g)	*D. molliculum* (g)	*M. piperita* (g)	Sample weight (g)
1	16.67	16.67	66.67	0.83	0.83	3.33	5.00
2	16.67	66.67	16.67	0.83	3.33	0.83	5.00
3	0.00	50.00	50.00	0.00	2.50	2.50	5.00
4	50.00	50.00	0.00	2.50	2.50	0.00	5.00
5	0.00	100.00	0.00	0.00	5.00	0.00	5.00
6	100.00	0.00	0.00	5.00	0.00	0.00	5.00
7	50.00	0.00	50.00	2.50	0.00	2.50	5.00
8	66.67	16.67	16.67	3.33	0.83	0.83	5.00
9	0.00	0.00	100.00	0.00	0.00	5.00	5.00
10	33.33	33.33	33.33	1.66	1.66	1.66	5.00
11	33.33	33.33	33.33	1.66	1.66	1.66	5.00
12	33.33	33.33	33.33	1.66	1.66	1.66	5.00

Ciocalteu's reagent diluted 1:10 and 400 μL of 7.5% (w/v) sodium carbonate solution, mixed and kept in the dark for 120 min, and the absorbance was measured at 740 nm. A standard curve of gallic acid (3,4,5-trihydroxybenzoic acid from Sigma-Aldrich) was prepared with concentrations of 1, 2, 4, 6, 8, and 10 μg/mL dissolved in water. Results were expressed as mg of gallic acid per 100 g of tea (mg of GAE/100 g).

Determination of flavonoids in aqueous extract

Modifications to the methodology described by Vega et al. (2017). When measuring flavonoids, 100 μL of tea extract was mixed with 30 μL of a 5% $NaNO_2$ solution. It was allowed to stand for 6 min, and then, 30 μL of 10% $AlCl_3$ was added. Finally, 200 μL of 1 M NaOH and 640 μL of water were added, and the mixture was left to stand for 30 min before a UV/VIS spectrophotometer reading was taken at 415 nm. With concentrations of 4, 10, 20, and 40 μg of Cat/mL dissolved in water, a catechin standard curve (Sigma-Aldrich) was constructed. The results were reported as mg of catechin equivalent per gram of tea (mg CAT/g).

Determination of antioxidant activity in aqueous extract

The antioxidant activity of tea extracts was analyzed using the 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) method, as described by Yilmaz et al. (2015), with some modifications. Next, 800 μL of 100 μM DPPH was added to 200 μL of the diluted aqueous tea extract and vigorously shaken and incubated for 30 min at 25°C. The reading was then taken at 515 nm. For the calculations, the standard curve was prepared with a solution of Trolox (±) 6-hydroxy-2,5,7,8-tetramethyl-chromane-2-carboxylic acid (Sigma-Aldrich), and the total antioxidant activity was expressed as milli moles of Trolox equivalent per gram of tea (μmol Trolox/g).

Overall acceptability

Sixty untrained panelists assessed the general acceptability of all randomly coded tea blends. Overall acceptability was assessed using the structured nine-point scale (9=I like a lot, 8=I like a lot, 7=I like moderately, 6=I like a little, 5=I neither like nor dislike at all, 4=I dislike a little, 3=I dislike moderately, 2=I dislike a lot, 1=I dislike a lot) modified from Lima (2007).

Design and statistical analysis

An extended centroid unrestricted simplex mixture design was used for the combination of *E. arvense* (EA, 0∼100%), *D. molliculum* (DM, 0∼100%), and *M. piperita* (M, 0∼100%), from which 12 treatments were obtained (Table 1). Subsequently, an ANOVA was applied to determine the linear, quadratic, or special cubic model representing the highest significance ($P<0.05$). Additionally, the coefficients of determination R^2 and adjusted R^2 were determined from values greater than 85% to validate the mathematical model, contour plots were also evaluated for each dependent variable, and finally, a multiresponse analysis was developed to have a more objective appreciation of the data. Statistical modeling was developed using Design-Expert® version 11.

RESULTS

Raw material characteristics

Table 2 shows the physicochemical properties of the dehydrated leaf samples for each plant.

Tea sample proportions design

Table 3 shows the values obtained for the 12 tea samples, from which we can interpret that as the tea blends contain a higher percentage of DM and a lower percentage of EA, the higher the number of total polyphenols, flavonoids, and antioxidant capacity of the tea, as can be seen in blends 2 and 5, where the percentages of DM range between 66.67 and 100% and the EA percentages range between 16.67 and 0%, giving results of 2,811.28±

Table 2. Physicochemical properties of dehydrated leaves of *Equisetum arvense*, *Desmodium molliculum*, and *Mentha piperita* plants used in tea preparation

Physicochemical properties	*E. arvense* (EA)	*D. molliculum* (DM)	*M. piperita* (M)
Humidity (%)	6.08±0.24	5.99±0.75	6.76±0.45
pH	7.34±0.79	6.68±0.53	6.53±0.23
Total polyphenols (mg EAG/100 g)	940.76±29.92	2,897.49±43.15	2,020.67±31.40
Antioxidant capacity (μmol Trolox/g)	35.09±3.34	135.28±8.54	90.69±5.09
Flavonoids (mg CAT/g)	12.15±0.27	44.33±0.16	19.13±1.92

Table 3. Total polyphenols, flavonoids, and antioxidant capacity of tea blends made from dried *Equisetum arvense*, *Desmodium molliculum*, and *Mentha piperita* plants

Mixture	Total polyphenols (mg EAG/100 g)		Flavonoids (mg CAT/g)		Antioxidant capacity by DPPH (μmol Trolox/g)	
	Observed	Predicted	Observed	Predicted	Observed	Predicted
1	2,714.55±40.67	2,039.85	32.20±0.44	24.61	118.02±6.10	87.55
2	2,811.28±36.55	2,527.50	37.05±0.40	33.07	145.82±6.16	126.38
3	2,374.43±68.46	2,577.71	32.07±1.27	32.93	112.89±6.17	122.80
4	2,161.92±42.59	1,939.43	27.27±0.97	24.90	106.86±5.22	94.72
5	2,974.49±54.25	3,065.35	39.73±0.19	41.39	155.08±6.58	161.64
6	950.96±19.29	813.50	10.19±0.49	8.42	33.99±2.46	27.80
7	1,280.37±4.53	1,451.78	15.35±0.21	16.44	48.83±4.28	55.88
8	1,196.84±7.30	1,401.57	13.94±0.56	16.59	50.54±1.65	59.46
9	2,000.70±41.50	2,090.07	22.73±1.43	24.47	81.49±4.19	83.97
10	1,840.60±20.08	1,989.64	23.44±0.60	24.76	86.71±7.31	91.13
11	1,790.92±24.26	1,989.64	22.56±1.13	24.76	77.17±3.82	91.13
12	1,778.60±17.50	1,989.64	20.57±0.11	24.76	76.18±3.75	91.13

DPPH, 2,2-diphenyl-1-picrylhydrazyl radical.

36.55 and 2,974.49±54.25 mg/EAG/100 g for total polyphenols, 37.05±0.40 and 39.73±0.19 mg CAT/g for flavonoids and 145.82±6.16 and 155.08±6.58 μmol Trolox/g for antioxidant capacity.

DISCUSSION

Raw material

Regarding the moisture percentage, the range ranges from 5.99% to 6.76%, the optimal moisture for tea brewing, as reported by Millones et al. (2014). It should be noted that Peruvian technical standard 209.228 for aromatic herbs allows dehydration up to a maximum moisture content of 12%. Regarding the pH level of the samples, they range between 6.53 and 7.34, positioning them at an almost neutral level with respect to pH, as established by Larrucea et al. (2013), where they analyzed the pH of infusions, such as green, black, chamomile, and mate tea, which ranged between 6.50 and 7.70.

The total polyphenols of the samples establish that DM (2,897.49±43.15 mg EAG/100 g) has a higher amount compared to M (2,020.67±31.40 mg EAG/100 g) and EA (940.76±29.92 mg EAG/100 g), whose values are close to those of Sadowska et al. (2016), who established total polyphenol values for M from 1,974.74 to 3,381.02 mg EAG/100 g, the lowest value being those that were not subjected to pressures between 50 to 200 MPa. Benítez and Pérez (2016) analyzed the total polyphenols of different aromatic herbs, observing an increase as the samples were subjected to drying (60°C), as was the case for EA, where values of 850 to 1,000 mg of EAG/100 g were obtained. In the case of DM, the total polyphenols of *Desmodium gangeticum* obtained by Venkatachalam and Muthukrishnan (2012) were 1,600.2±0.7 mg of EAG/100 g, while Gutiérrez et al. (2008) obtained 12,500.82±0.40 mg of EAG/100 g for DM, the herb by far the highest phenolic content of the 14 plants studied.

The highest number of flavonoids is also reflected in DM: 44.33±0.16 CAT/g, compared to M: 19.13±1.92 CAT/g, and EA: 12.15±0.27 CAT/g; these values exceed those of Benabdallah et al. (2016), who established flavonoid values for six varieties of Mentha ranging from 9.90 to 31.77, 15.70±0.10 CAT/g. Similarly, for EA, Ricco et al. (2011) found total flavonoid values of 24.37±2.65 mg CAT/g, 11.50±1.50 mg CAT/g, and 8.90±0.30 mg CAT/g for lateral branches, internode stems, and basal stems of *Equisetum giganteum*, respectively.

For the antioxidant capacity of the samples, it was observed that the highest amount corresponds to DM: 135.28±8.54 μmol Trolox/g, compared to M: 90.69±5.09 μmol Trolox/g, and EA: 35.09±3.34 μmol Trolox/g. These results reflect similarity to those reported by Benítez and Pérez (2016), who analyzed the antioxidant capacity of different aromatic herbs, where growth of antioxidant capacity was obtained according to the samples that were subjected to drying and grinding, as was the case of M, which obtained values of 50 to 110 μmol Trolox/g, and from 15 to 40 μmol Trolox/g for EA, as well as, for DM, Avella et al. (2008) obtained 221.30±1.01 μmol Trolox/g, being the plant with the best report regarding the antioxidant capacity of those studied.

Analysis of response surfaces

Fig. 2∼4 show the contour and response surfaces for total polyphenols, flavonoid content, and antioxidant capacity for EA, DM, and M, respectively. Fig. 5 shows the optimal ratios of EA, DM, and M required to maximize the total polyphenol content, the content of flavonoids, and the antioxidant capacity of each medicinal tea blend.

Fig. 2 shows that by increasing the content of *E. arvense* in brewed tea blends from 0% to 100%, the total polyphenol content decreased from approximately 2,690.04 to

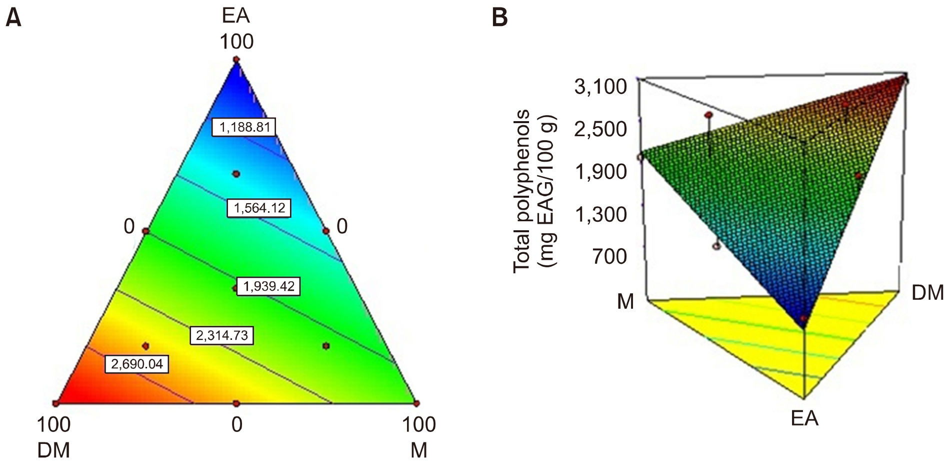

Fig. 2. Contours (A) and response surfaces (B) for total polyphenols with proportions of *Equisetum arvense* (EA), *Desmodium molliculum* (DM), and *Mentha piperita* (M) in medicinal tea blends.

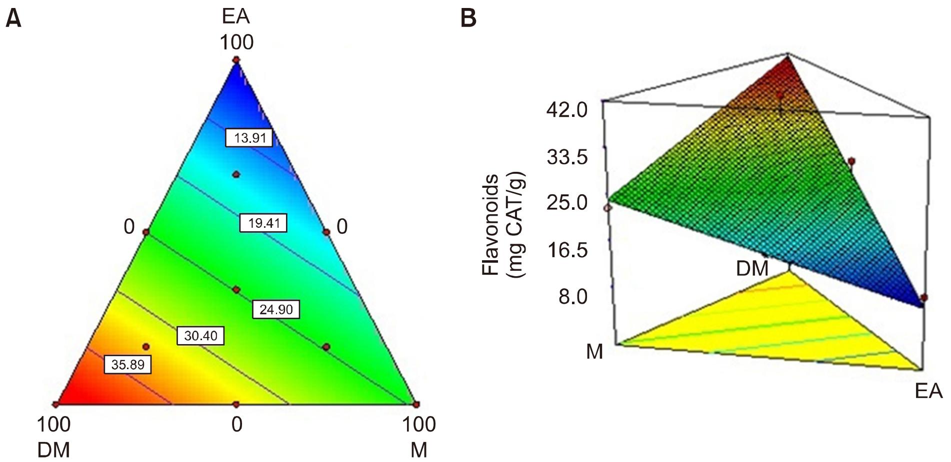

Fig. 3. Contours (A) and response surfaces (B) for flavonoids with proportions of *Equisetum arvense* (EA), *Desmodium molliculum* (DM), and *Mentha piperita* (M) in medicinal tea blends.

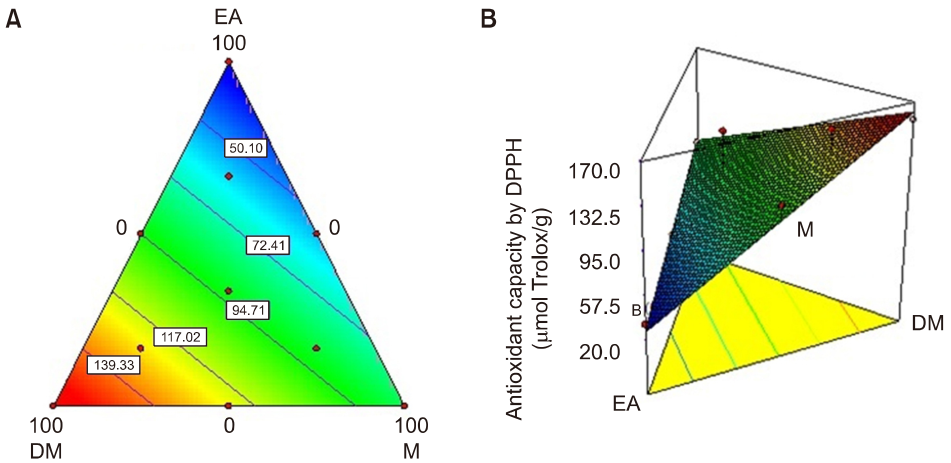

Fig. 4. Contours (A) and response surfaces (B) for antioxidant capacity with proportions of *Equisetum arvense* (EA), *Desmodium molliculum* (DM), and *Mentha piperita* (M) in medicinal tea blends. DPPH, 2,2-diphenyl-1-picrylhydrazyl radical.

Factors	Optimum
EA	6.59%
DM	84.62%
M	8.79%
Responses	
Total polyphenols	2,831.18 mg EAG/100 g
Flavonoids	37.73 mg CAT/g
Antioxidant capacity by DPPH	145.99 μmol Trolox/g

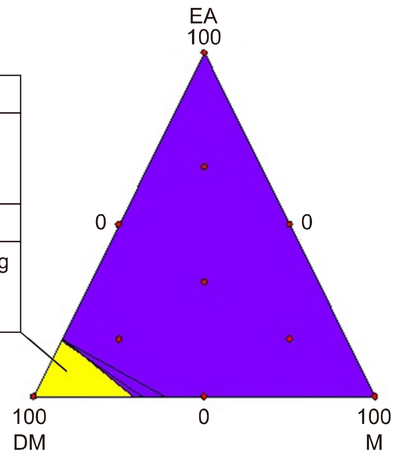

Fig. 5. Optimization of *Equisetum arvense* (EA), *Desmodium molliculum* (DM), and *Mentha piperita* (M) for the responses: total polyphenols, flavonoids, and antioxidant capacity in medicinal tea blends. DPPH, 2,2-diphenyl-1-picrylhydrazyl radical.

1,188.81 mg of EAG/100 g. With reference to *M. piperita*, by increasing the ratio from 0% to 100%, the total polyphenols are approximately maintained in 1,938.42 mg EAG/100 g, and with reference to *D. molliculum*, it is observed that by increasing the ratio from 0% to 100% the total polyphenols increase from approximately 1,564.12 to 2,690.04 mg EAG/100 g.

Fig. 3 shows that when the *E. arvense* content in tea blends increased from 0% to 100%, the flavonoid content decreased from approximately 35.89 to 13.91 mg CAT/g; when the *M. piperita* content increased from 0% to 100%, the flavonoids remained around 24.90 mg CAT/g; and when the *D. molliculum* content increased from 0% to 100% the flavonoids slightly increased from 19.41 to 35.89 mg CAT/g.

Fig. 4 shows that when the EA content in the tea blends increased from 0% to 100%, the antioxidant capacity decreased from approximately 117.02 to 50.10 μmol Trolox/g, with reference to M. When increasing the ratio from 0% to 100%, the antioxidant capacity remained around 94.71 μmol Trolox/g, while in the case of DM, the antioxidant capacity increased slightly more than double, from 72.41 to 139.33 μmol Trolox/g.

Fig. 5 indicates a multiple response analysis in which an overlap of the response variables under study was performed, taking into account the maximization of the total polyphenol content (2,831.18 mg EAG/100 g), flavonoids (37.73 mg CAT/g) and antioxidant capacity (145.99 μmol Trolox/g), with the optimal mixture comprising; 6.59% for EA, 84.62% for DM, and 8.79% in M. These amounts indicate that the total amount of polyphenols, flavonoids, and antioxidant capacity in the blends increases with the amount of DM and decreases with the amount of EA and M used in tea preparation. DM contains high concentrations of bioactive components, as reported by Avella et al. (2008), who obtained 12,500.82± 0.40 mg of EAG /100 g for total phenols and 221.30± 1.01 μg/mL for the antioxidant capacity of DM. Similarly, Vipin et al. (2015) and Vaghasiya (2009) reported flavonoid values for *Desmodium gyran* and *D. gangeticum*, which contained 70.50±2.00 mg CAT/g and 37.02±0.15 mg CAT/g, respectively, thus ratifying the high functional value of this species.

It confirms what has previously been reported, namely that the decrease or increase of the functional properties of medicinal plants is typically related to the plant's variety, sowing date, cutting time, substrate salinity, temperature, storage time, speed, and time of dehydration of its structures, primarily the leaves (Benabdallah et al., 2016; Benítez and Pérez, 2016; Pastoriza et al., 2017; Pérez-Burillo et al., 2018).

The astringency and bitterness of some infused blends are often associated with toxicity and play a role in influencing product acceptance or rejection; however, bitter compounds have many bioactive benefits (Li et al., 2023), so a tolerable bitter taste is acceptable in plant-produced foods, such as the infused blends studied.

The total polyphenol content (2,831.18 mg EAG/100 g), flavonoids (37.73 mg CAT/g) and antioxidant capacity (145.99 μmol Trolox/g) were obtained with the optimal combination of dried plants of 6.59% for *E. arvense*, 84.62% for *D. molliculum*, and 8.79% for *M. piperita* in tea infusions after maximization of the variables. Notably, there is strong correlation between antioxidant capacity and total polyphenols (R^2, 0.98), antioxidant capacity and flavonoids (R^2, 0.99), and between total flavonoids and polyphenols (R^2, 0.98), indicating that both total polyphenols and flavonoids contribute significantly to antioxidant activities of the plants and in prepared teas, providing a significant source of bioactive molecules that would provide therapeutic benefits to those who consume them.

General acceptability

Fig. 6 shows the results of sensory acceptability, which reveal that the most accepted blends by the panelists were three (0% EA; 50% DM; 50% M), five (0% EA; 100% DM; 0% M) and nine (0% EA; 0% DM; 100% M) found on a hedonic scale of 5.02±0.25; 6.02±0.13 and 7.20±0.51, respectively. Their acceptability ranges from

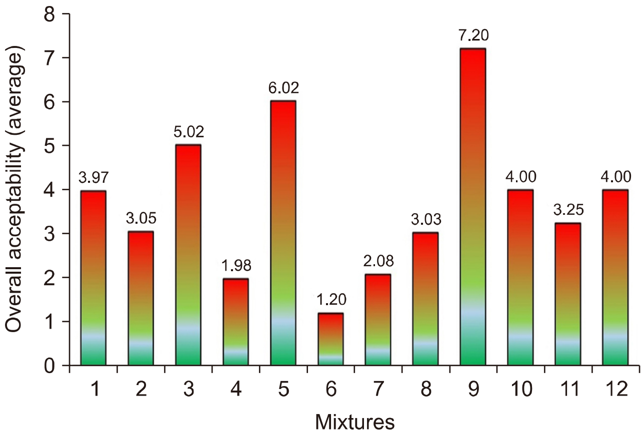

Fig. 6. The general acceptability of medicinal tea blends.

"neither like nor dislike" to "moderately like," it should be noted that the three mixtures show significant differences ($P<0.05$). The least accepted blends were four (50% EA; 50% DM; 0% M), six (100% EA; 0% DM; 0% M), and seven (50% EA; 0% DM; 50% M), found on a hedonic scale of 1.98±0.29, 1.20±0.44, and 2.08±0.50, respectively; whose acceptability ranges from "I dislike it very much," it should be noted that the three blends also present significant differences ($P<0.05$). However, we can say that the acceptability will improve as long as *E. arvense* is not increased. Furthermore, according to our optimal overlay in Fig. 6, the functional components are maximized with "moderate" acceptability in the proportion of 6.59% for *E. arvense*, 84.62% for *D. molliculum*, and 8.79% for *M. piperita*.

Due to the abundance of phytochemical kingdoms involved in flavor and aroma related to their volatile and nonvolatile compound structures, as well as preparation steps, the reported association between tea composition and sensory profile is problematic, as they do not always correspond (Lee et al., 2013; Zhu et al., 2017; Pan et al., 2022). Bitter compounds have many bioactive benefits (Li et al., 2021), so a tolerable bitter taste is acceptable in plant-produced foods such as the infused blends studied.

Chota, a province in the Cajamarca region, is a producer of numerous herbs with little-studied functional properties. In order to further expand the functional benefits of new infused products that are much healthier and to encourage the reduction of the excessive consumption of conventional sugars, it is recommended to conduct research employing diverse experimental designs and new natural plants with established therapeutic potential.

Conclusions

Maximizing the variables resulted in the total content (2,831.18 mg EAG/100 g), flavonoids (37.73 mg CAT/g), and antioxidant capacity (145.99 μmol Trolox/g), which were obtained with the optimal combination of dried plants consisting of 6.59% for *E. arvense*, 84.62% for *D. molliculum*, and 8.79% for *M. piperita* in tea infusions. In contrast, in the sensory analysis, greater overall acceptability (I moderately like it) was obtained for the maximization of the functional components, which were previously mentioned. This demonstrates that both total polyphenols and flavonoids contribute significantly to the antioxidant activities of the plant and prepared teas, thereby providing a source of bioactive molecules with a relevant sensory appreciation for consumers seeking a healthy lifestyle and/or therapeutic benefits.

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None.

AUTHOR DISCLOSURE STATEMENT

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Concept and design: JSC. Analysis and interpretation: JSC, OSC, JOD, OGR, HGC, MGC, LIG. Data collection: OGR, HGC, MGC, LIG. Writing the article: JSC. Critical revision of the article: JSC, OSC. Final approval of the article: all authors. Statistical analysis: OSC, JOD. Overall responsibility: JSC.

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