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Supplementary Material

Sexual dimorphism in the dioecious monocot *Lomandra leucocephala* ssp. *robusta* and its potential ecosystem and conservation significance

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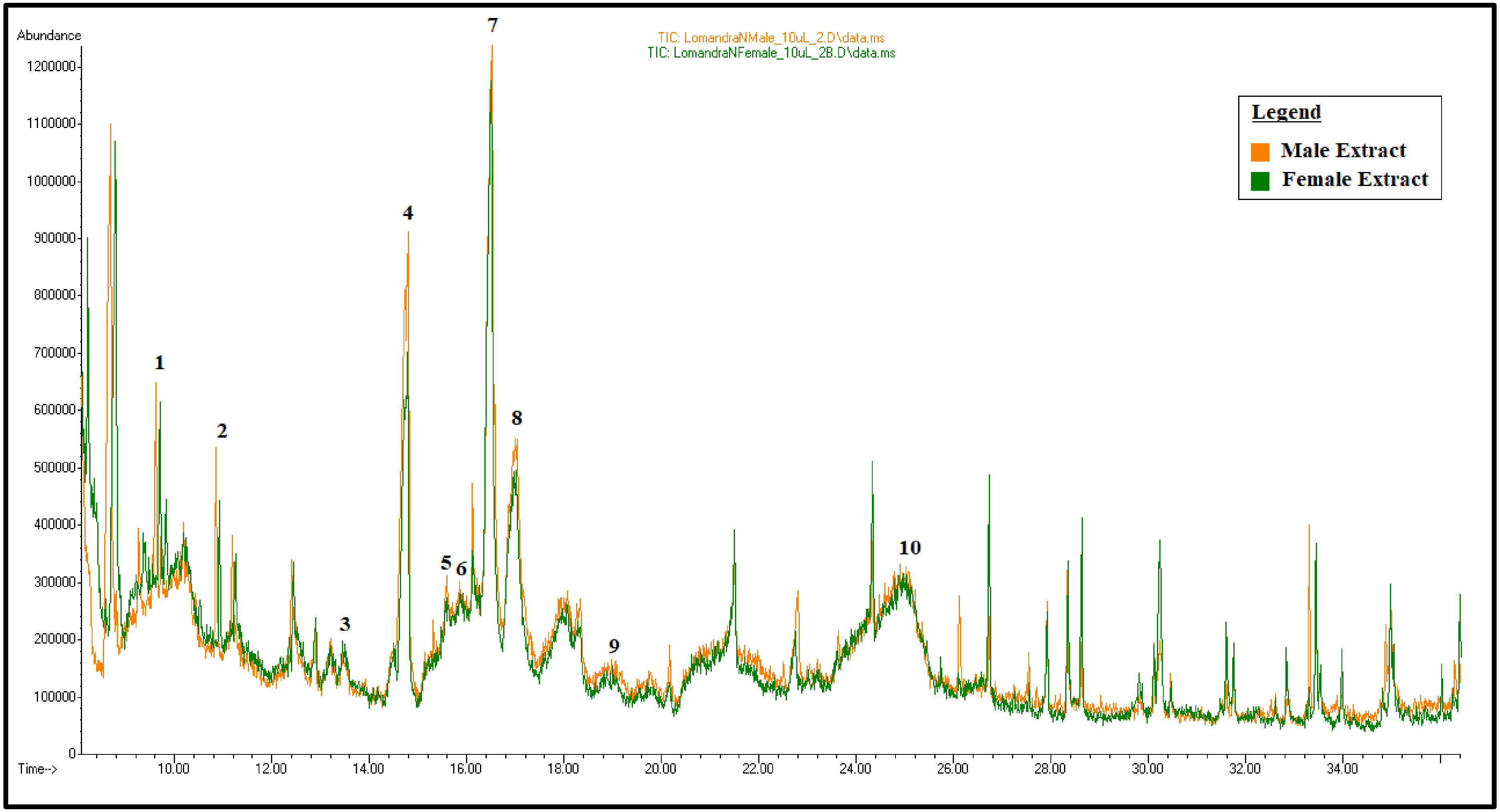

Fig. S1. Overlayed GC-MS chromatogram of male (yellow) and female (green) floral methanol extracts. Numbered peaks include those with the greatest difference in area % between sexes.

Table S1. Table of peak retention time, peak area, identification and quality match of methanolic floral extracts analysed by GC-MS, numbered according to SM 1, with compounds in common underlined

Peak number	Sex	Retention time (min)	Peak area (%)	Top three compound matches	Match quality
1	Male	9.620	1.73	<u>4,5-Dihydro-2-methylimidazole-4-one</u> 2,3-2H-4-Methyl-imidazole-2-one <u>1,3-Dihydro-4-methyl-2H-imidazol-2-one</u>	83 74 74
	Female	9.710	3.09	<u>1,3-Dihydro-4-methyl-2H-imidazol-2-one</u> <u>4,5-Dihydro-2-methylimidazole-4-one</u> 2-Methyl-3,4,5,6-tetrahydropyrazine	78 50 25
2	Male	10.195	2.57	<u>1,3-Dihydroxy-2-propanone</u> <u>dl-Glyceraldehyde dimer</u> 1-Propanol	74 64 59
	Female	10.189	4.67	<u>1,3-Dihydroxy-2-propanone</u> <u>Glycoaldehyde dimer</u> 1,3-Dihydroxyacetone dimer	56 53 40
3	Male	13.458	0.70	Butanedial 1,2,15-Pentadecanetriol Ethoxymethyl-oxirane	49 42 40
	Female	13.447	1.85	2-Nitro-1-butanol Hydrazinecarboxylic acid, ethyl ester Butoxymethyl-oxirane	33 33 25
4	Male	14.800	8.50	<u>2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one</u> <u>2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one</u> 2,4,5-Trimethyl-1,3-dioxolane	87 62 35
	Female	14.79	4.79	<u>2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one</u> <u>2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one</u>	74 43

				4-Methyl-1,3-dioxane	25
5	Male	15.590	2.26	Ethoxymethyl-oxirane 1,1,1-Triethoxy-propane N-Aminomorpholine, Glyoxal imine	42 40 35
	Female	15.597	3.09	2,3-Dihydroxy-propanal 7-n-Pentadecylaminomethyl-6-hydroxy-5,8-quinolinedione DL-Arabinose	56 40 39
6	Male	15.860	2.28	<u>DL-Arabinose</u> DL-Xylose 2,3-Dihydroxy-propanal	50 32 25
	Female	15.854	1.15	<u>DL-Arabinose</u> 2,3-Dihydroxy-propanal d-Glycero-d-ido-heptose	50 43 45
7	Male	16.513	11.47	Trifluoro-acetic acid, ethyl ester <u>1-Ethoxy-2,2,2-trifluoro-ethanol</u> 1,1,1-Trifluoro-2-butanone	9 9 7
	Female	16.495	9.98	<u>1-Ethoxy-2,2,2-trifluoro-ethanol</u> Ethanesulfonyl chloride Pentyl hydroperoxide	10 4 2
8	Male	16.986	8.64	<u>1,2,3-Propanetriol, monoacetate</u> 3-Hydroxy-4-methyl-pentanoic acid, methyl ester 1,2,3-propanetriol, 1-acetate	64 50 50
	Female	17.028	6.53	<u>1,2,3-Propanetriol, monoacetate</u> 2,3-Butanedione, monooxime 2,3-Pentanedione	39 17 17

9	Male	18.980	1.75	Carbonic acid, diethyl ester d-Glycero-d-ido-heptose Carbamic acid, (2-chloroethylidene)bis-, diethyl ester	50 45 45
	Female	18.998	1.09	Ethylene glycol diglycidyl ether Vitamin d3 2-Deoxy-D-galactose	53 42 37
10	Male	24.903	10.43	Acetic acid, hydroxy-, ethyl ester Methyl 3,6-anhydro-α-D-glucopyranoside Ethyl ether	72 50 50
	Female	29.975	8.32	Carbamic acid, (2-chloroethylidene)bis-, diethyl ester d-Glycero-d-ido-heptose sec-Butyl nitrite Ethylene glycol diglycidyl ether	40 37 37 37

Table S2. Table of compound activities for compounds identified to be in the top three quality matches in male and/or female methanolic floral extracts analysed by GC-MS (yellow shading = in male extract only, green = in female extract only, grey = in male and female extract)

Peak number	Compound	Information	Reference
1	4,5-Dihydro-2-methylimidazole-4-one	Anticancer activity	Sunil KS, Akki S, Ashika BD, Chitrali LR, Naresh S, Balasubramanian S (2018) GCMS and FTIR analysis on the methanolic extract of *Coriandrum sativum* leaves. *European Journal of Pharmaceutical and Medical Research* **5**, 454-460.
1	2,3-2H-4-Methyl-imidazole-2-one	-	None found
	2H-Imidazol-2-one, 1,3-dihydro-4-methyl-	-	None found
1	2-Methyl-3,4,5,6-tetrahydropyrazine	-	None found
2	1,3-Dihydroxy-2-propanone	1. Three carbon sugar, is used in lots of metabolic pathways, is phosphorylated and made into a hexose for carbon synthesis, carrier of phosphate for moving between the cytosol and chloroplast, oxidised to pyruvate. 2. Has a ‘sweet’, ‘cool’ taste.	1. Gee, RW, Byerrum, RU, Gerber, DW, Tolbert, NE (1988) Dihydroxyacetone phosphate reductase in plants. *Plant Physiology* **86,** 98-103. 2. Birch, G (1976) Structural relationships of sugars to taste. *CRC Critical Reviews in Food Science and Nutrition* **8**, 57 - 95.
2	1-Propanol	Fermentation product	None found

2	dl-Glyceraldehyde dimer	1. Triose sugar, is used in glycolysis as a carrier of phosphate as it is added to make G3P. 2. Is sweet tasting to humans.	1. Allaby, M (2012) Glyceraldehyde. In 'A Dictionary of Plant Sciences.' (Ed. M Allaby.) (Oxford University Press: England) 2. Oertly, E, Myers, R (1919) A new theory relating constitution to taste. Simple relations between the constitution of alipathic compounds and their sweet taste. *Journal of the American Chemical Society* **41**, 855 - 876.
2	1,3-Dihydroxyacetone dimer	Dimer of 1,3-dihydroxy-2-propanone,	(see references on 1,3-dihydroxy-2-propanone)
3	1,2,15-Pentadecanetriol	Also found in Coriandrum flowers	Dharmalingam R, Nazni P (2013) Phytochemical evaluation of *Coriandrum* L flowers. *International Journal of Food and Nutritional Sciences* **2**, 34-39.
3	Butanedial	1. Also found in medicinal hibiscus flowers 2. Hibiscus flowers have a wide variety of medicinal uses	1. Rassem HHA, Nour AH, Yunus RM (2017) GC-MS analysis of bioactive constituents of *Hibiscus* flower. *Australian Journal of Basic and Applied Sciences* **11**, 91-97. 2. Missoum A (2018) An update review on *Hibiscus rosa sinensis* phytochemistry and medicinal uses. *Journal of Ayurvedic and Herbal Medicine* **4**, 135-146.
3	Ethoxymethyl-oxirane	Also called ethylene oxide, it can be derived from ethylene (which is a plant growth regulator) after use in cellular processes and in the presence of oxygen	K.D. Golden and O.J. Williams, 2014. Ethylene Oxide in Plant Biological Systems: A Review. *Asian Journal of Biological Sciences* **7**, 144-150.
3	2-Nitro-1-butanol	-	None found
3	Hydrazinecarboxylic acid, ethyl ester	Potentially a natural insecticide	Attia S, Grissa KL, Lognay G, Bitume E, Hance T, Mailleux AC (2013) A review of the major biological approaches to control the worldwide pest *Tetranychus urticae* (Acari: Tetranychidae) with special reference to natural pesticides. *Journal of Pest Sciences* **86**, 361-386.
3	Butoxymethyl-oxirane	-	(see references on ethoxymethyl oxirane)

4	2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one	1. Antioxidant 2. Makes up a considerable quantity of date palm fruit extract, which has good antioxidant activity 3. Also found in garden mint	1. Yu, X, Zhao, M, Liu, F, Zeng, S,Hu, J (2013) Identification of 2,3 dihydro-3,5 dihydroxy-6-methyl-4H pyran-4-one as a strong antioxidant in glucose–histidine Maillard reaction products. *Food Research International* **51**, 397-403. 2. Siddeeg, A, Zeng, X-A, Ammar, AF, Han, Z (2019) Sugar profile, volatile compounds, composition and antioxidant activity of Sukkari date palm fruit. *Journal of Food Science and Technology* **56**, 754-762. 3. Imad, HH, Hussein, JH, Muhanned, AK, Nidaa, SH (2015) Identification of five newly described bioactive chemical compounds in methanolic extract of Mentha viridis by using gas chromatography - mass spectrometry (GC-MS). *Journal of Pharmacognosy and Phytotherapy* **7**, 107-125.
4	2,4,5-Trimethyl-1,3-dioxolane	Has been identified as a main constituent in crude extracts of walnut tree bark which also exhibited antimicrobial properties Also a common component in wine, sherry and brandy	Ara I, Shinwari MMA, Rashed SA, Bakir MA (2013) Evaluation of antimicrobial properties of two different extracts of *Juglans regia* tree bark and search for their compounds using gas chromatography-mass spectrum. *International Journal of Biology* **5**, 92 – 102.
4	4-Methyl-1,3-dioxane-	-	None found
5	1,1,1-Triethoxy-propane	-	None found
5	N-Aminomorpholine, Glyoxal imine	Found in the butanol extracts of Merrimia borneensis at 1% of total extract,	Hossain MA, Shah MD, Sakari M (2011) Gas chromatography-mass spectrometry analysis of various organic extracts of *Merremia borneensis* from Sabah. *Asian Pacific Journal of Tropical Medicine*, 637 – 641.
5	2,3-Dihydroxy-propanal	1. Found in hibiscus extract and is antimicrobial and an antioxidant 2. Also found in some Saudi honeys depending on the	1. Imad, HH, Hussein, JH, Muhanned, AK, Nidaa, SH (2015) Identification of five newly described bioactive chemical compounds in methanolic extract of Mentha viridis by using gas chromatography - mass spectrometry (GC-MS). *Journal of Pharmacognosy and Phytotherapy* **7**, 107-125. 2. Alotibi IA, Harakeh SM, Al-Mamary M, Mariod AA, Al-Jaouni SK, Al-

		cultivar which show varying degrees of antimicrobial activity 3. Also found in the reasonably high quantities in floral volatiles of a few tree peony cultivars	Masaud S, Alharbi MG, Al-Hindi RR (2018) Floral markers and biological activity of Saudi Honey. *Saudi Journal of Biological Sciences* **25**, 1369 – 1374. 3. Zhao J, Hu Zeng-hui H, Leng P, Zhang H, Cheng F (2012) Fragrance composition in six peony cultivars. *Korean Journal of Horticultural Science and Technology* **30**, 617 – 625.
5	7-n-Pentadecylaminomethyl-6-hydroxy-5,8-quinolinedione	-	None found
6	DL-Arabinose	1. Part of cell wall polysaccharides 2. Helps to maintain cell wall integrity and therefore assists with cell wall tolerance under high salt conditions 3. Arabinose concentrations fall as flowers mature and senesce as the cell walls degrade	1. Burget EG, Verma R, Molhoj M, Reiter W (2003) The biosynthesis of l-arabinose in plants: Molecular cloning and characterization of a golgi-localised UDP-D-xylose 4-epimerase encoded by the *MUR4* gene of Arabidopsis. *The Plant Cell* **15**, 523 – 531. 2. Zhao C, Zayed O, Zeng F, Liu C, Zhang L, Zhu P, Hsu C, Tuncil YE, Tao WA, Carpita NC, Zhu J (2019) *New Phytologist* **224**, 274 – 290. 3. O'Donoghue EM (2006) Flower petal cell walls: Changes associated with flower opening and senescence. *New Zealand Journal of Forestry Science* **36**, 130 – 144.
6	DL-Xylose	1. A nectar sugar but is not proven to be able to be digested by any birds or insects that consume it mixed with other sugars the nectar 2. Also might be toxic to bees at too high a quantity	1. Allsopp MH, Jackson S (1998) Xylose as a nectar sugar: The response of cape honeybees, *Apis mellifera capensis* Eschschoitz (Hymenoptera: Apidae). *Comparative Biochemistry and Physiology Part B* **131**, 613 – 620. 2. Crane E (1978) On the scientific front. *Bee World* **59**, 37 – 38.

6	d-Glycero-d-ido-heptose	Found in Ayuredic medicines but is metabolised in the fermentation production into some other products that may contribute to their antioxidant effect	Vinothkanna A, Soundarapandian S (2018) Influence of intrinsic microbes on phytochemical changes and antioxidant activity of the Ayurvedic fermented medicines: *Balarishta* and *Chandanasava*. *Ayu* **39**, 169 – 181.
9	Carbonic acid, diethyl ester	-	None found
9	Acetic acid, trifluoro-, ethyl ester	-	None found
7	1-Ethoxy-2,2,2-trifluoro-ethanol	-	None found
7	1,1,1-Trifluoro-2-butanone	Also found in medicinal plant *Gigantochloa ligulata*	Peng, W, Wu, Y-Q, Song, Y (2009) 'Evaluation on Application Potential of Gigantochloa ligulata for Biomedicine, 2009 Third International Conference on Bioinformatics and Biomedical Engineering.' Beijing, China. (IEEE. Available at http://ieeexplore.ieee.org.proxy.library.adelaide.edu.au/stamp/stamp.jsp?tp=&arnumber=5162805&isnumber=5162128)
7	Ethanesulfonyl chloride	-	None found
7	Pentyl hydroperoxide	Also found in flowers of Pogostemon quadriflorus	Jisha M, Zeinul NHH, Leena P (2016) GC-MS analysis of leaves and flowers of *Pogostemon quadriflorus* (Benth.) F.Muell.(Lamiaceae). *World Journal of Pharmaceutical Research* **5**, 667 – 681.
8	1,2,3-Propanetriol, monoacetate	1. Precursor to an antifungal and has antimicrobial, anti-inflammatory and anticancer effects from Broussonetia luzonica extracts	1. Casuga FP, Castillo AL, Corpuz MJT (2016) GC-MS analysis of bioactive compounds present in different extracts of an endemic plant *Broussonetia luzonica* (Blanco) (Moraceae) leaves. *Asian Pacific Journal of Tropical Medicine* **6**, 957 – 961. 2. El-Sharkawy HHA, Rashad YM, Ibrahim SA (2018) Biocontrol of stem rust disease of whear using arbuscular mycorrhizal fungi and *Trichoderma* spp.

		2. Antifungal activity in test study of *Trichoderma* spp. 3. Insecticidal from *Calotropis gigantea* extracts 4. Found also in saffron honey	*Physiological and Molecular Plant Pathology* **103**, 84 – 91. 3. Habib R, Karim MR (2016) Chemical characterization and insecticidal activity of *Calotropis gigantea* L. flower extract against *Tribolium castaneum* (Herbst). *Asian Pacific Journal of Tropical Disease* **6**, 996 – 999. 4. Nayik GA, Nanda V (2015) Characterisation of the volatile profile of unifloral honey from Kashmir Valley of India by using solid-phase microextraction and gas chromatorgraphy-mass spectrometry. *European Food Research and Technology* **240**, 1091 – 1100.
8	3-Hydroxy-4-methyl-pentanoic acid, methyl ester	-	None found
8	1,2,3-Propanetriol, 1-acetate	1. Also found in pomegranate peel extracts 2. Is also found in extracts of *Mucuna pruriens linn* seeds and is antibacterial 3. Also found in extracts of *Wedelia biflora*	1. Harini K, Mohan CC, Karthikeyan RS, Sukumar M (2018) Effect of *Punica granatum* peel extracts on antimicrobial properties in Walnut shell cellulose reinforced bio-thermoplastic starch films from cashew nut shells. *Carbohydrate Polymers* **184**, 231 – 242. 2. Jhariya S, Kakkar A (2016) Analysis of bioactive components from ethyl acetate and ethanol extracts of *Mucuna pruriens linn* seeds by GC-MS technique. *Journal of Chemical and Pharmaceutical Research* **8**, 403 – 409. 3. Arockia SP, Amaladasan M, Gowri J, Dharmalingam V, Prabha A, Rajendran R (2015) Gas chromatography-mass spectrometry analysis of different solvent crude extracts from the coastal region of *Wedelia biflora*.L. *International Research Journal of Biological Sciences* **4**, 1 – 5.
8	2,3-Butanedione, monooxime	Is a non-muscular myosin inhibitor	Radford FE, White RG (2011) Inhibitors of myosin, but not actin, alter transport through *Tradescantia* plasmodesmata. *Protoplasma* **248**, 205-216.
8	2,3-Pentanedione	Found in *Viola tianshanica* essential oil, which has antioxidant activity	Yan J, Qu Z, Xiao Y, Qiu G, Zhang T, Wu Z, He X, Hu X (2010) Chemical composition and antioxidant activity of the essential oil of endemic *Viola tianshanica*. *Natural Product Research* **25**, 1635 – 1640.
9	Vitamin d3	Is responsible in plants as well as animals for calcium	Boland RL (1986) Plants as a source of vitamin D_3 metabolites. *Nutrition Reviews* **44**, 1 – 8.

		intake, which can effect plant growth	
9	Carbamic acid, (2-chloroethylidene)bis-, diethyl ester	-	None found
9	2-Deoxy-D-galactose	Toxic to termites in a delayed response	Veillon LJ (2003) The biological activity of rare carbohydrates and cyclitols in *Coptotermes formosanus*. Liuisiana State University Digital Commons, USA.
10	Acetic acid, hydroxy-, ethyl ester	-	None found
10	.alpha.-D-Glucopyranoside, methyl 3,6-anhydro-	-	None found
10	Ethyl ether	-	None found
10	sec-Butyl nitrite	-	None found
10	Ethylene glycol diglycidyl ether	-	None found

Table S3. Tables of T-test assuming equal variance results testing for differences in peak area between northern and southern male, and northern and southern female *L. leucocephala* ssp. *robusta* (α = 0.05)

Peak	North male average peak area ratio	South male average peak area ratio	*P*-value	T-statistic
1	0.47678	0.39968	0.4870	0.76479
2	0.25255	0.17344	0.2434	1.3669
3	0.51413	0.65761	0.3531	-1.0498
4	4.7419	4.0262	0.5310	0.68496

Peak	North female average peak area ratio	South female average peak area ratio	*P*-value	T-statistic
1	0.74840	0.58671	0.4854	0.76791
2	0.50589	0.31758	0.2268	1.4269
3	0.92089	0.70540	0.4052	0.92956
4	7.7838	5.9406	0.3899	0.96332