Supplementary Information

Table S1: Effect of the total ethanol extract of *P. emblica* fruit and its fractions on uterine weight, serum estradiol and vaginal cornification in immature ovariectomized female albino rats for estimation of estrogenic activity (n=6)

Groups	Uterine weight (g100g-1 b.wt.)	% increase in uterine weight	Serum estradiol Pg mL^{-1}	Vaginal cornification score*
Vehicle (control)	0.05 ± 0.001	-	3.3 ± 0.2	0
Ethinyl estradiol (50 µg kg b.wt.$^{-1}$)	0.2 ± 0.02**	277	17.6 ± 0.7**	3
TE (250 mg/kg b.wt.$^{-1}$)	0.09 ± 0.02	73	12.7 ± 0.2**	2
PE fraction (250 mg/kg b.wt.$^{-1}$)	0.23 ± 0.03**	340	21.7 ± 2.2**	3
CH fraction (250 mg/kg b.wt.$^{-1}$)	0.16 ± 0.14**	211	15.5 ± 1.2**	3
EA fraction (250 mg/kg b.wt.$^{-1}$)	0.07 ± 0.017	42	3.8 ± 0.2	0
BU fraction (250 mg/kg b.wt.$^{-1}$)	0.08 ± 0.021	46	4.2 ± 0.2	1

TE: Total ethanol extract; PE: Petroleum ether fraction; CH: Chloroform fraction; EA: Ethyl acetate fraction; BU: Butanol fraction
Data presented as means ± SD
** Significant at $p< 0.01$ as compared with negative control group
- Statistical analysis performed using one-way analysis of variance (ANOVA) accompanied by Costat computer program using Least Significant Difference (LSD) at $p< 0.01$.

***Vaginal cornification score**
0 Diestrus smear, mainly leucocytes few nucleated epithelial cells
1 Mixture of leucocytes and nucleated epithelial cells.
2 Proestrus smear, mainly nucleated and some cornified cells may be present.
3 Estrus smear, cornified cells.
Animals showing a score of 2 or 3 are considered positive.

Table S2: Effect of total ethanolic extract of *P. emblica* fruit and its fractions on genitalia weight, count of follicular population at different stages and number of *corpora lutea* in immature female albino rats in experiment for estimation of gonadotropic activity (n=6)

Groups	FSH-like activity			LH-like activity
	Genitalia weight (g 100g b.wt.$^{-1}$)	**% increase in genitalia weight**	**Total follicles**[1]	**Number of *corpora lutea* (C.L.)** [1]
Vehicle (control)	0.13 ± 0.002	-	9.3 ± 0.5 ^{g}	2.66 ± 1.15^{e}
Positive control PMSG (1 IU)	0.53 ± 0.2**	293	17± 1 ^{e}	12 ± 2 ^{d}
Positive control hCG 1 IU				
PMSG 5 IU	0.63 ± 0.2**	364	18.3± 0.5 ^{c,d}	22 ± 1.3 ^{c}
hCG 5 IU				
PMSG 10 IU	0.68 ± 0.1**	400	23.3 ± 0.5 ^{b}	27.3 ± 2.2^{b}
hCG 10 IU				
PMSG 20U	0.87 ± 0.06**	544	26.3 ± 0.5 ^{a}	39 ± 1.2 ^{a}
hCG 20 IU				
TE (250 mg b.wt.$^{-1}$)	0.18 ± 0.003	32	12.5 ± 1.2 ^{f}	6 ± 2.3^{e}
PE fraction (250 mg kg b.wt.$^{-1}$)	0.2 ± 0.05**	54	17.3 ± 0.5 ^{d,e}	20 ±2 ^{c}
CH fraction (250 mg kg b.wt.$^{-1}$)	0.28 ± 0.1**	105	26 ± 1 ^{a}	20.7 ± 3 ^{c}
EA fraction (250 mg kg b.wt.$^{-1}$)	0.14 ± 0.03	5	9.3 ± 0.5 ^{g}	3.3 ± 1.1^{e}
BU fraction (250 mg kg b.wt.$^{-1}$)	0.22 ± 0.01**	63	19.4 ± 1 ^{c}	30 ± 2 ^{b}

TE: Total ethanol extract; PE: Petroleum ether fraction; CH: Chloroform fraction; EA: Ethyl acetate fraction; BU: Butanol fraction

PMSG: Pregnant mare serum gonadotropin, hCG: Human chorionic gonadotropin

Data presented as means ± SD

** Significant at $p< 0.05$ as compared with negative control group

Statistical analysis performed using one-way analysis of variance (ANOVA) accompanied by Costat computer program using least significant difference (LSD) at $p<0.05$

[1]Unshared superscript letters indicate values of significant difference between groups ($p<0.05$)

Blue shaded cells denote doses of human chorionic gonadotropin (hCG) positive control for LH-like activity assay and their results

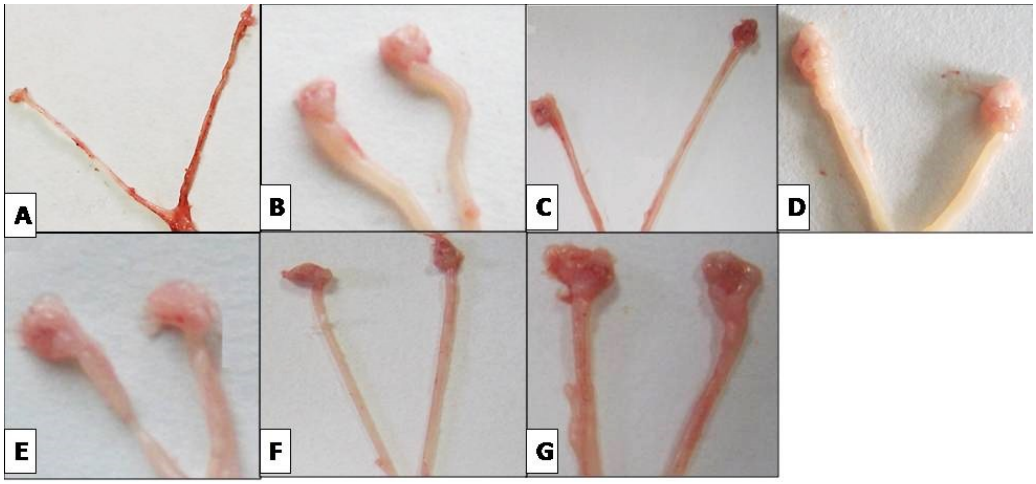

Fig. S1. Photographs of genitalia of immature female rats in experiment for estimation of FSH-like activity (x1.5).

A: Normal control group (vehicle) showing thin thread-like uterine horns with scanty amounts of uterine secretions; **B**: Positive control group (Pregnant mare's serum gonadotropin (PMSG); 5IU/rat) showing short uterine horns with thin membranes and filled with large amounts of uterine fluid; **C**: TE extract, 250 mg kg b.wt.$^{-1}$ showing thin, elongated uterine horns, filled with scanty amounts of uterine secretions; **D**: PE fraction, 250 mg kg b.wt.$^{-1}$ showing short uterine horns filled with uterine secretions; **E**: CH fraction, 250 mg kg b.wt.$^{-1}$ showing short uterine horns filled with large amounts of uterine fluids; **F**: EA fraction, 250 mg kg b.wt.$^{-1}$ showing thin thread-like uterine horns with scanty amounts of uterine secretions; **G**: BU-fraction, 250 mg kg b.wt.$^{-1}$ showing short uterine horns, engorged with uterine secretions.

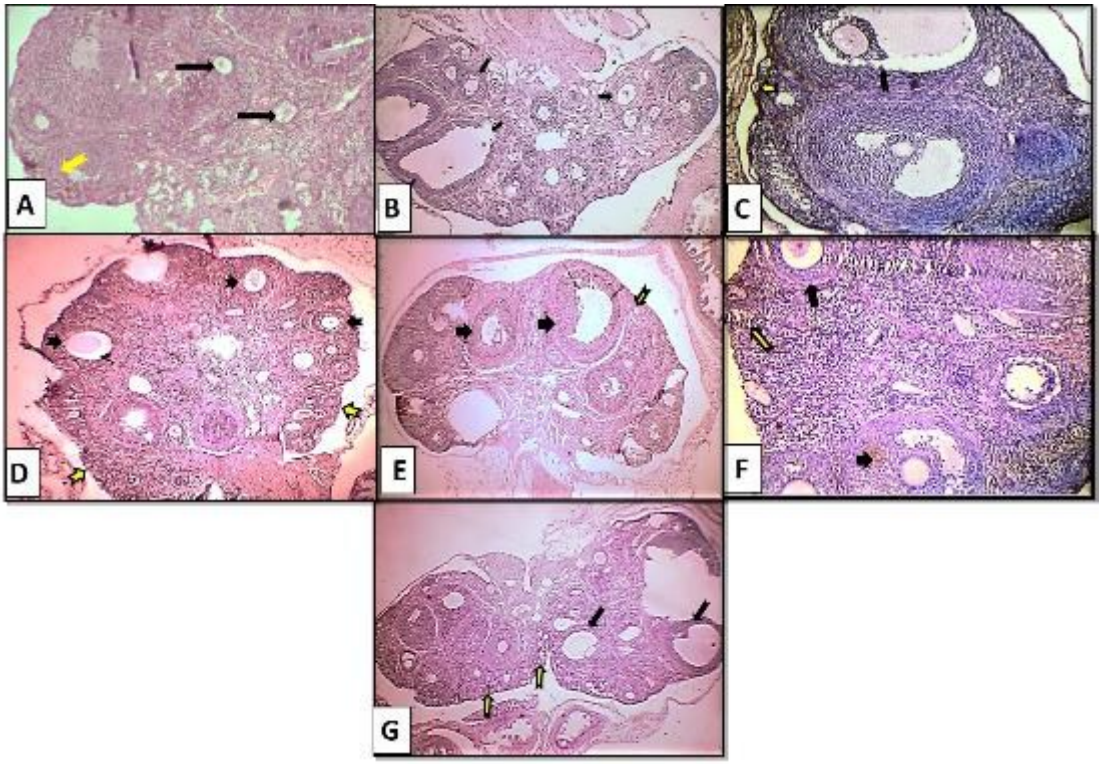

Fig. S2. Cross section in the ovaries of immature female rats in experiment for estimation of FSH-like activity (H&E, x40).

A: Normal control group (vehicle) showing normal follicular proliferation with moderate numbers of follicles in all stages; mature Graafian follicles, secondary follicles, and primordial follicles; **B**: Positive control group (Pregnant mare's serum gonadotropin (PMSG); 5IU/rat) showing enlarged ovaries with hyperactivity of follicular proliferation showing large numbers of follicles at different developmental stages mostly Graafian follicles and mature antral follicles; **C**: TE extract, 250 mg kg b.wt.$^{-1}$ showing few follicular maturation with few of follicles as mature antral follicles with moderate primordial follicles (x100); **D**: PE fraction, 250 mg kg b.wt.$^{-1}$ showing moderate follicular maturation with some follicles appearing as mature antral follicles, large numbers of primary and primordial follicles; **E**: CH fraction, 250 mg kg b.wt.$^{-1}$ showing good follicular proliferation, large numbers of Graafian follicles, few numbers of primary and primordial follicles; **F**: EA fraction, 250 mg kg b.wt.$^{-1}$ showing few follicular maturation with few follicles as mature antral follicles and few primordial follicles (x100); **G**: BU-fraction, 250 mg kg b.wt.$^{-1}$ showing good follicular activity with large numbers of mature Graafian follicles with few numbers of primary and primordial follicles present. Black arrow: mature follicles; yellow arrow: primordial follicles.

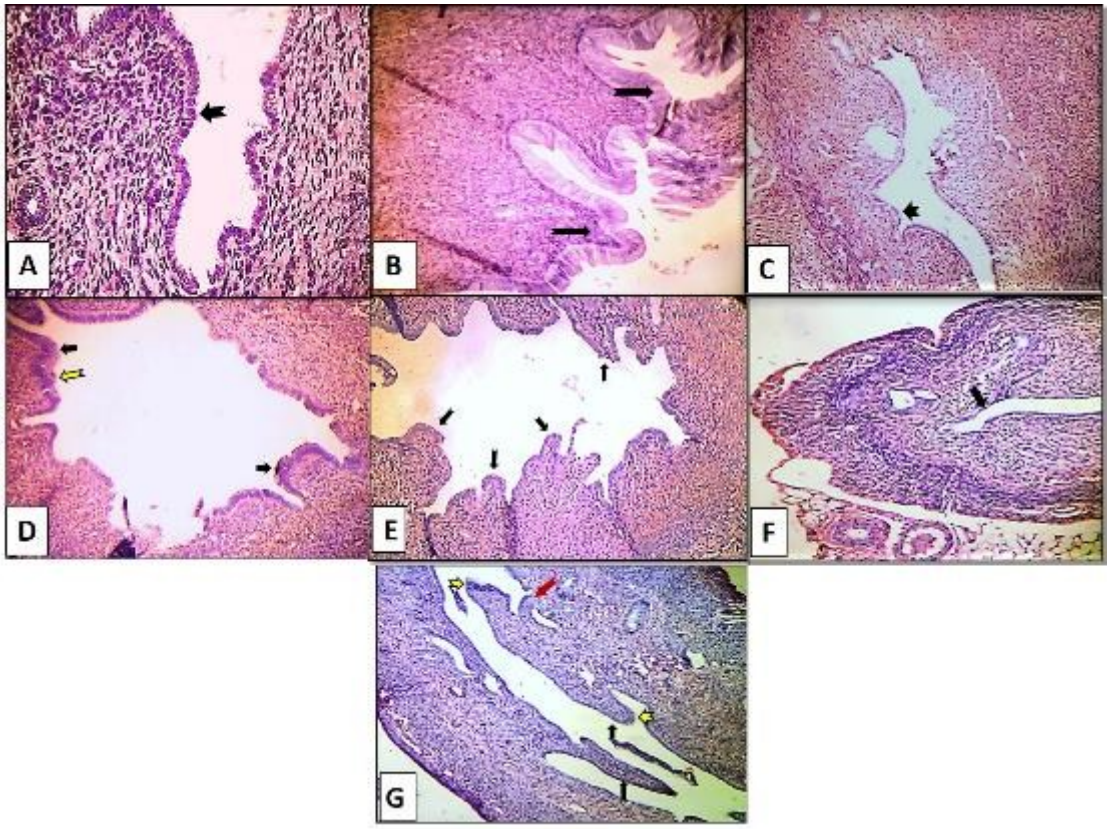

Fig. S3. Histological micrographs in the uteri of immature female rats in experiment for estimation of FSH-like activity (H&E, x100).

A: Normal control group (vehicle) showing normal uterine activity, the endometrium appeared normal with simple columnar epithelium and simple glandular activity (x200); **B**: Positive control group (Pregnant mare's serum gonadotropin (PMSG); 5IU/rat) showing progestational proliferative activity of uteri, with increase in the height of the lining epithelium and formation of villus like projections; **C**: TE extract, 250 mg kg b.wt.$^{-1}$ showing normal endometrial proliferation with normal height of lining epithelium and mild finger like projection (villus formation); **D**: PE fraction, 250 mg kg b.wt.$^{-1}$ showing moderate endometrial proliferation with normal height of lining epithelium, finger like projection accompanied by mild hyperplasia and normal uterine glands; **E**: CH fraction, 250 mg kg b.wt.$^{-1}$ showing moderate endometrial proliferation, with normal height of lining epithelium and finger like projections (x200); **F**: EA fraction, 250 mg kg b.wt.$^{-1}$ showing normal flattened endometrial mucosa with normal height of the lining epithelium, no obvious hyperplasia and normal appearance of uterine glands; **G**: BU-fraction, 250 mg kg b.wt.$^{-1}$ showing moderate endometrial proliferation, with normal thickening of endometrial epithelium and villus-like projections formation accompanied by mild hyperplasia and moderate glandular activity. Black arrow: endometrial epithelium.; yellow arrow: hyperplasia, red arrow: glandular activity.

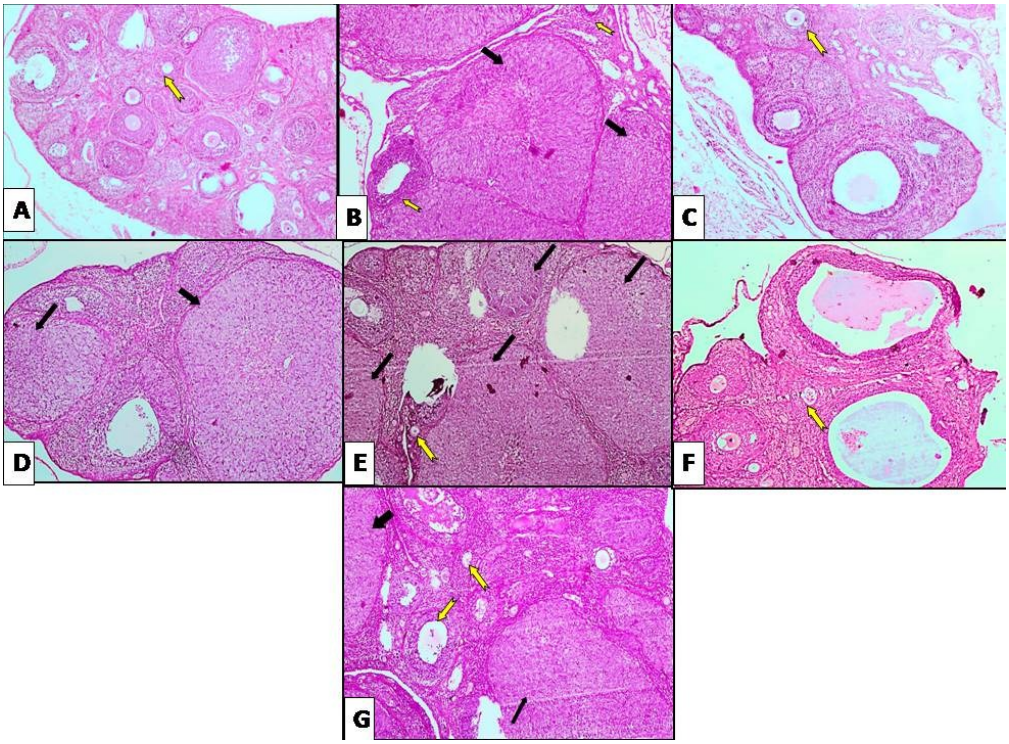

Fig. S4. Cross section in ovaries of immature female rats in experiment for estimation of LH-like activity (H&E, x40).

A: Normal control group (vehicle) showing moderate numbers of follicles in all stages; **B**: Positive control group (Human chorionic gonadotropin (hCG), 5 IU/rat) showed high luteinizing activity, *corpora lutea* appearing adjacent to each other with few compressed secondary follicles in between; **C**: TE extract, 250 mg kg b.wt.$^{-1}$ showing normal follicular activity with moderate numbers of mature follicles; **D**: PE fraction, 250 mg kg b.wt.$^{-1}$ showing high luteinizing activity; **E**: CH fraction, 250 mg kg b.wt.$^{-1}$ showing high luteinizing activity with multiple *corpora lutea* adjacent to each other; **F**: EA fraction, 250 mg kg b.wt.$^{-1}$ showing moderate follicular activity and low luteinizing activity; **G**: BU-fraction, 250 mg kg b.wt.$^{-1}$ showing luteinizing hyperactivity, large numbers of *corpora lutea* with few numbers of follicles in different stages. Black arrow: *corpora lutea*; yellow arrow: secondary follicles.

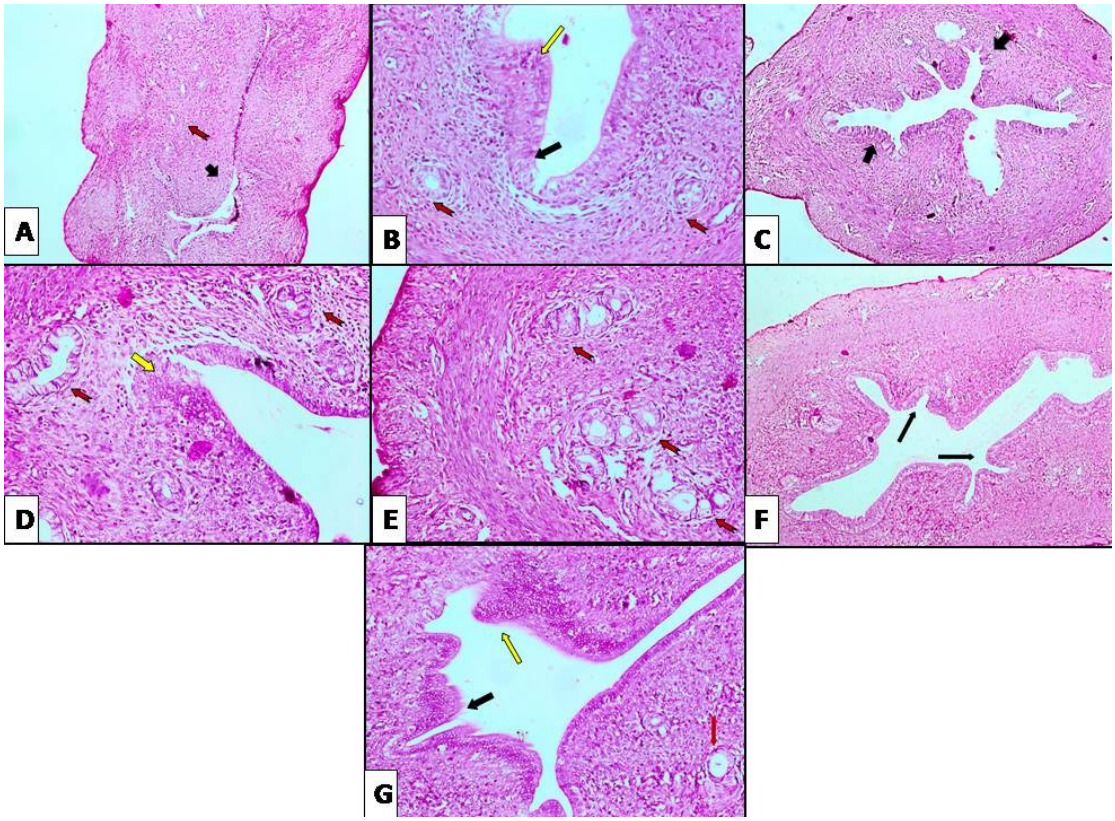

Fig. S5. Histological micrographs in the uteri of immature female rats in experiment for estimation of LH-like activity (H&E, x40).

A: Normal control group (vehicle) showing normal endometrial activity with mild folding and normal thickening of the endometrial lining epithelium with normal size and appearance of uterine glands; **B**: Positive control group (Human chorionic gonadotropin (hCG), 5 IU/rat) showing increase in the height of endometrial epithelium associated with multifocal hyperplasia of endometrial epithelium and good glandular activity (x100); **C**: TE extract, 250 mg kg b.wt.$^{-1}$ showing moderate folding in endometrium associated with increase the height of its lining epithelium and normal endometrial glands; **D**: PE fraction, 250 mg kg b.wt.$^{-1}$ showing focal hyperplasia in the lining epithelium of endometrium associated with moderate endometrial gland activity; **E**: CH fraction, 250 mg/kg showing hyperactivity of the uterine glands (coiled glands) (x100); **F**: EA fraction, 250 mg kg b.wt.$^{-1}$ showing mild papillary projection of endometrial epithelium (x100); **G**: BU-fraction, 250 mg kg b.wt.$^{-1}$ showing moderate multifocal hyperplasia with moderate folding in endometrial surface and good glandular activity. Black arrow: endometrial epithelium; yellow arrow: hyperplasia; red arrow: glandular activity.

Table S3: Metabolites annotated in *P. emblica* fruit total ethanol extract and its fractions via UPLC-qTOF-MS in positive and negative ionization modes.

Peak No.	R_t (min.)	Mol. ion *m/z* [-/+]	Error (ppm)	Formula	MS/MS fragments	Tentative Identification	Class	TE	BU	EA	CH	PE
1	0.85	179.0562 **[M-H]**$^-$	6.621	$C_6H_{11}O_6^-$	161	Hexose	Sugar	-	+	-	-	-
2	0.92	209.0302**[M-H]**$^-$	4.862	$C_6H_9O_8^-$	**191**, 173, 147, 125, 103, 85	Mucic acid	Organic acid	+	+	+	-	-
3	0.97	331.0667 **[M-H]**$^-$	2.045	$C_{13}H_{15}O_{10}^-$	313, 271, 211, **169**, 151,125	Galloylhexose	Gallotannin	+	+	-	+	+
4	1.04	361.0412 **[M-H]**$^-$	2.819	$C_{13}H_{13}O_{12}^-$	343, 317, **209**, 191, 147	Mucic acid gallate	Gallotannin	+	+	-	-	-
5	1.06	133.0143 **[M-H]**$^-$	8.873	$C_4H_5O_5^-$	**115**, 71	Malic acid	Organic acid	-	-	-	+	-
6	1.31	129.0194 **[M-H]**$^-$	9.571	$C_5H_5O_4^-$	**85,** 71	Methylene-succinic acid (itaconic acid)	Organic acid	-	-	-	+	-
7	1.32	169.0143 **[M-H]**$^-$	6.628	$C_7H_5O_5^-$	**125**	Gallic acid	Gallic acid derivative	+	-	+	-	+
8	1.42	375.0567 **[M-H]**$^-$	2.474	$C_{14}H1_5O_{12}^-$	343, 299,**223,**191	Mucic acid methyl ester gallate	Gallotannin	+	-	-	-	-
9	1.46	343.0303 **[M-H]**$^-$/ 345.0453 **[M+H]**$^+$	2.077	$C_{13}H_{11}O_{11}^-$	299,**191**, 147, 129	Mucic acid lactone gallate	Gallotannin	+	+	+	-	-
10	1.82	389.0721 **[M-H]**$^-$	1.613	$C_{15}H_{17}O_{12}^-$	357, 237, 191, **169**	Mucic acid dimethyl ester gallate	Gallotannin	+	+	+	+	-
11	2.05	143.035 **[M-H]**$^-$	7.584	$C_6H_7O_4^-$	143, 125, **99,** 71	Methyl itaconate	Organic acid	-	-	-	+	-
12	2.77	483.0766 **[M-H]**$^-$	0.748	$C_{20}H_{19}O_{14}^-$	331, 313, **271**, 211, 169	Digalloyl hexose	Gallotannin	+	+	-	-	-
13	3.06	321.0251 **[M-H]**$^-$	2.934	$C_{14}H_9O_9^-$	277, **169**, 125	Digallic acid	Gallic acid derivative	-	-	+	-	-
14	3.59	183.0298 **[M-H]**$^-$	5.301	$C_8H_7O_5^-$	**168,** 151, **124**	Methyl gallate (gallicin)	Gallic acid derivative	+	-	+	+	-
15	3.64	265.0927 **[M-H]**$^-$	3.569	$C_{10}H_{17}O_8^-$	**191,** 173, 147	Tetra-*O*-methyl galactarate (tetra-*O*-methyl mucic acid)	Organic acid	-	+	-	-	-
16	4.21	357.0457 **[M-H]**$^-$/ 359.0609 **[M+H]**$^+$	1.435	$C_{14}H_{13}O_{11}^-$	339, 325, 205,**169**	Mucic acid lactone methyl ester gallate	Gallotannin	+	+	+	+	-

Peak No.	R_t (min.)	Mol. ion *m/z* [-/+]	Error (ppm)	Formula	MS/MS fragments	Tentative Identification	Class	TE	BU	EA	CH	PE
17	6.95	299.0409 **[M-H]**$^-$	3.784	$C_{12}H_{11}O_9^-$	281, 267, 255, 237, 223, 205, **169**	Trimethoxybenzene-tricarboxylic acid	Phenolic compound	+	-	+	-	-
18	8.57	633.071 **[M-H]**$^-$	1.99	$C_{27}H_{21}O_{18}$	463, **301,** 275	Galloyl-hexahydroxydiphenoyl-hexoside	Ellagitannin	+	+	+	+	-
19	9.24	463.0507 **[M-H]**$^-$/ 465.0667 **[M+H]**$^+$	0.007	$C_{20}H_{15}O_{13}^-$	445, **301**	Ellagic acid hexoside	Ellagitannin	+	+	+	-	-
20	9.28	783.07 **[M+H]**$^+$	1.924	$C_{34}H_{23}O_{22}^+$	463, 337, **303**, 277	Emblicanin A	Ellagitannin	+	+	+	-	-
21	9.35	951.0709 **[M-H]**$^-$	1.24	$C_{41}H_{27}O_{27}^-$	**933**, 613,301	Geraniin	Ellagitannin	+	+	-	-	-
22	9.61	197.0454 **[M-H]**$^-$	4.974	$C_9H_9O_5^-$	**169,** 153, 124	Ethyl gallate (Phyllemblin)	Gallic acid derivative	-	-	-	+	-
23	9.64	371.0619 **[M-H]**$^-$/ 373.0764 **[M+H]**$^+$	2.62	$C_{15}H_{15}O_{11}^-$	353, 327,309, 281, 237, 219, **169,** 157,125	Di-*O*-methyl mucic acid lactone gallate	Gallotannin	+	+	+	+	-
24	9.85	617.08 **[M+H]**$^+$	0.379	$C_{27}H_{21}O_{17}^+$	599, 303, **277**	Phyllanemblinin A	Ellagitannin	+	-	+	-	-
25	9.88	785.0815 **[M-H]**$^-$	0.864	$C_{34}H_{25}O_{22}^-$	741, **633**, 463, 301	Digalloyl-HHDP glucose	Ellagitannin	+	-	+	-	-
26	10	787.0982 **[M-H]**$^-$	2.2	$C_{34}H_{27}O_{22}^-$	635, **617**, 483, 465, 313, 169	Tetragalloyl hexose	Gallotannin	+	+	+	-	-
27	10.11	417.1039 **[M-H]**$^-$	2.631	$C_{17}H_{21}O_{12}^-$	399, 372, **265,** 191, 169	Tri-*O*-methyl mucic acid methyl ester gallate	Gallotannin	+	+	+	-	-
28	10.26	785.08 **[M+H]**$^+$	1.792	$C_{34}H_{25}O_{22}^+$	483, 465, 321, **303**, 277	Pedunculagin	Ellagitannin	+	+	+	-	-
29	10.28	953.0874 **[M-H]**$^-$	1.754	$C_{41}H_{29}O_{27}^-$	935, 909, 853, 801, 783, 633, 481, **476,** 463,301	Chebulagic acid	Ellagitannin	+	+	+	-	-
30	10.41	300.9985 **[M-H]**$^-$/ 303.01 **[M+H]**$^+$	2.015	$C_{14}H_5O_8^-$	**301**, 283, 271, 257, 229, 185	Ellagic acid	Ellagitannin	+	+	+	+	+
31	10.49	313.0567 **[M-H]**$^-$/ 315.0714 **[M+H]**$^+$	4.126	$C_{13}H_{13}O_9^-$	295, 267, 249, 223**, 169,** 161, 143,125	Norbergenin	Gallic acid derivative	+	+	+	+	-
32	10.58	431.1192 **[M-H]**$^-$	1.919	$C_{18}H_{23}O_{12}^-$	413, **399**, 381, 357, 197, 169	Tri-*O*-methyl mucic acid-O-dimethoxy hydroxy benzoate	Gallotannin	+	+	+	-	-
33	10.73	399.0929 **[M-H]**$^-$	1.684	$C_{17}H_{19}O_{11}^-$	381, 325, 281,	Di-*O*-methyl mucic acid	Gallotannin	-	+	+	-	-

Peak No.	R_t (min.)	Mol. ion *m/z* [-/+]	Error (ppm)	Formula	MS/MS fragments	Tentative Identification	Class	TE	BU	EA	CH	PE
		/401.11 **[M+H]**$^+$			247, 185, **169**	lactone methyl ester-*O*-methoxy dihydroxybenzoate						
34	10.85	415.12 **[M+H]**$^+$	2.087	$C_{18}H_{23}O_{11}^+$	359, 313, 207, 171, **153**	Di-*O*-methyl mucic acid lactone methyl ester-*O*-dimethoxy hydroxybenzoate	Gallotannin	-	+	+	-	-
35	11.08	397.0774 **[M-H]**$^-$/ 399.09 **[M+H]**$^+$	2.071	$C_{17}H_{17}O_{11}^-$	**365**, 353, 333, 321, 289, 275	Trimethyl ether chebulic acid	Ellagitannin	-	-	-	+	-
36	11.06	749.06 **[M+H]**$^+$	1.946	$C_{34}H_{21}O_{20}^+$	731, 447, **303**, 277	Ellagitannin	Ellagitannin	+	+	+	-	-
37	11.09	917.0685 **[M-H]**$^-$	0.652	$C_{41}H_{25}O_{25}^-$	747, 458, **301,** 169	Mallotusinin	Ellagitannin	+	-	+	-	-
38	11.17	355.1033 **[M-H]**$^-$	2.651	$C_{16}H_{19}O_9^-$	**309**, 207, 179,147	Unknown	Unknown	+	-	-	-	-
39	11.22	335.0406 **[M-H]**$^-$/ 337.0554 **[M+H]**$^+$	2.572	$C_{15}H_{11}O_9^-$	**183**, 168, 124	Methyl digallate	Gallic acid derivative	-	-	+	+	-
40	11.34	303.05 **[M+H]**$^+$	1.411	$C_{15}H_{11}O_7^+$	**285**, 275, 257, 247, 229, 165, 137	Quercetin	Flavonoid	+	-	-	-	-
41	11.41	227.128 **[M+H]**$^+$	0.9	$C_{12}H_{19}O_4^+$	227, **209**, 191, 163	Tuberonic acid (hydroxy jasmonic acid)	Organic acid	-	-	-	+	+
42	11.42	445.1351 **[M-H]**$^-$	2.286	$C_{19}H_{25}O_{12}^-$	427, **399**, 371, 355, 313, 283, 211,169	Tri-*O*-methyl mucic acid-O-trimethoxybenzoate	Gallotannin	-	+	+	-	-
43	11.64	569.1146 **[M-H]**$^-$	1.492	$C_{24}H_{25}O_{16}^-$	**417**, 265,169	Di-*O*-methyl mucic acid di-methyl ester-di-*O*-gallate	Gallotannin	-	+	+	-	-
44	11.75	187.0975 **[M-H]**$^-$	5.262	$C_9H_{15}O_4^-$	169, 143, **125**	Azelaic acid	Organic acid	-	-	-	-	+
45	11.77	429.14 **[M+H]**$^+$	1.716	$C_{19}H_{25}O_{11}^+$	411, 373, 327, 185, **153**	Di-O-methyl mucic acid lactone methyl ester-*O*-trimethoxy benzoate	Gallotannin	-	+	+	-	-
46	12.19	327.0725 **[M-H]**$^-$	4.53	$C_{14}H_{15}O_9^-$	295, 281, **169,** 125	Bergenin	Gallic acid derivative	-	-	+	+	-
47	12.39	271.1186 **[M-H]**$^-$	3.597	$C_{13}H_{19}O_6^-$	253, 209, **191**	Unknown	Unknown	-	-	-	-	+
48	13.08	301.1281 **[M+H]**$^+$	2.151	$C_{14}H_{21}O_7^+$	283, **253**, 235	Unknown	Unknown	+	-	-	-	-

Peak No.	R_t (min.)	Mol. ion *m/z* [-/+]	Error (ppm)	Formula	MS/MS fragments	Tentative Identification	Class	TE	BU	EA	CH	PE
49	13.09	911.1709 **[M+H]**$^+$	0.189	$C_{40}H_{31}O_{25}^+$	457, **153**	Tri-*O*-galloyl-4-*O*-brevifolincarboxyl-*β*-D-glucose	Gallotannin	-	+	+	-	-
50	13.1	473.1654 **[M-H]**$^-$	0.121	$C_{21}H_{29}O_{12}^-$	455,**399**, 381, 211, 169	Tri-*O*-methyl mucic acid di-methyl ester-*O*-trimethoxybenzoate	Gallotannin	-	+	+	-	-
51	13.11	341.0875 **[M-H]**$^-$	2.379	$C_{15}H_{17}O_9^-$	295, **169,** 125	Methyl bergenin	Gallic acid derivative	-	-	+	+	-
52	13.33	269.103 **[M-H]**$^-$	3.736	$C_{13}H_{17}O_6^-$	251, 223, **207**, 195, 179	Unknown	Unknown	-	-	-	-	+
53	13.5	287.0555 **[M+H]**$^+$	0.08	$C_{15}H_{11}O_6^+$	269, 258, 241, 231, 213,**165**, 153, 133, 121	Kaempferol	Flavonoid	-	-	+	-	-
54	13.52	325.2277 **[M+H]**$^+$	1.84	$C_{21}H_{29}N_2O^+$	307, **233**	Unknown nitrogenous compound	Unknown	+	-	-	+	+
55	13.8	327.2177 **[M-H]**$^-$	3.482	$C_{18}H_{31}O_5^-$	309, **291,** 269, 251, 211, 183, 171	Trihydroxy octadecadienoic acid	Fatty acid	-	-	-	-	+
56	13.85	241.105 **[M+H]**$^+$	10.653	$C_{12}H_{17}O_5^+$	223, 213, 185, 171	Gallate derivative	Gallic acid derivative	+	+	+	-	-
57	14	441.1391 **[M+H]**$^+$	1.397	$C_{20}H_{25}O_{11}^+$	423, 409, **367,** 353, 335, 307	Tri-methyl ether, tri-methyl ester Chebulic acid	Ellagitannin	-	-	+	-	-
58	14.02	226.1804 **[M+H]**$^+$	1.521	$C_{13}H_{24}NO_2^+$	**208**,173, 163	Unknown	Unknown	+	-	-	-	-
59	14.05	247.1337 **[M+H]**$^+$	3.233	$C_{15}H_{19}O_3^+$	219, 201, **173**	Epoxyguaia-dien-olide	Sesquiterpene	-	-	-	+	+
60	14.12	355.1035 **[M-H]**$^-$	3.271	$C_{16}H_{19}O_9^-$	323, 311, 281, 237, **169**	Gallate derivative	Gallic acid derivative	-	-	+	-	-
61	14.16	329.2334 **[M-H]**$^-$	3.582	$C_{18}H_{33}O_5^-$	311, 293**,** 249, **229,** 211, 171	Trihydroxy octadeca-enoic acid	Fatty acid	-	-	-	-	+
62	14.17	257.0822 **[M-H]**$^-$	5.347	$C_{15}H_{13}O_4^-$	**213,** 151, 107	Methoxy - (phenyl methoxy) benzoic acid	Phenolic compound	-	-	-	+	-
63	14.44	205.0871 **[M-H]**$^-$	5.945	$C_{12}H_{13}O_3^-$	187, **161**	Unknown	Unknown	-	-	-	-	+
64	14.78	369.119 **[M-H]**$^-$ / 371.1339 **[M+H]**$^+$	2.659	$C_{17}H_{21}O_9^-$	325, 295, 169	Gallate derivative	Gallic acid derivative	-	-	+	-	-
65	15.65	451.2317 **[M+H]**$^+$	2.115	$C_{24}H_{35}O_8^+$	379, 313, 285, 227, **209**	Unknown	Unknown	-	-	-	-	+

Peak No.	R_t (min.)	Mol. ion *m/z* [-/+]	Error (ppm)	Formula	MS/MS fragments	Tentative Identification	Class	TE	BU	EA	CH	PE
66	16	311.2227 **[M-H]**$^-$	3.226	$C_{18}H_{31}O_4^-$	**293,** 275, 201	Dihydroxy octadeca-dienoic acid	Fatty acid	-	-	-	+	+
67	16.53	313.2381 **[M-H]**$^-$	2.535	$C_{18}H_{33}O_4^-$	**295**, 277, 267, 183	Dihydroxy octadecenoic acid	Fatty acid	-	-	-	-	+
68	17.12	476.2767 **[M+H]**$^+$	2.129	$C_{23}H_{43}NO_7P^+$	**458,**335, 261	Lysophosphatidylethanol-amine (18:3)	Phospholipid	+	-	+	-	-
69	17.14	595.2886 **[M-H]**$^-$	4.5	$C_{27}H_{48}O_{12}P^-$	415, 315, **279**, 241	Hydroxy[(hydroxy([penta hydroxycyclohexyl]oxy) phosphoryl)oxy]propyl-octadecadienoate LPI (18:2)	Phospholipid	-	-	-	+	-
70	17.32	518.3241 **[M+H]**$^+$	1.088	$C_{26}H_{49}NO_7P^+$	**500,** 258, 184	Linolenoyl-lysophosphatidylcholine (18:3) LYSO-PC	Phospholipid	+	-	+	+	-
71	17.34	293.2123 **[M-H]**$^-$	4.054	$C_{18}H_{29}O_3^-$	**275**, 265, 249	Hydroxy-octadecatrienoic acid	Fatty acid	-	-	-	-	+
72	17.4	315.2538 **[M-H]**$^-$	2.74	$C_{18}H_{35}O_4^-$	**297**, 279, 253	Dihydroxy octadecanoic acid	Fatty acid	-	-	-	-	+
73	17.59	571.2883 **[M-H]**$^-$	2.5	$C_{25}H_{48}O_{12}P^-$	409, 391, 315, **255**, 241	Hydroxy[(hydroxy ([pentahydroxycyclohexyl] oxy) phosphoryl) oxy] propyl palmitate LPI (16:0)	Phospholipid	-	-	-	+	-
74	17.6	291.1964 **[M-H]**$^-$	3.224	$C_{18}H_{27}O_3^-$	273, **247,** 219	Oxooctadecatrienoic acid	Fatty acid	-	-	-	-	+
75	17.83	478.2929 **[M+H]**$^+$	1.012	$C_{23}H_{45}NO_7P^+$	**460,** 337, 263	Lysophosphatidylethanola mine (18:2)	Phospholipid	+	-	+	+	-
76	17.96	301.216 **[M+H]**$^+$	0.587	$C_{20}H_{29}O_2^+$	283, 273, **259**	Hydroxyabieta-trien-one	Diterpene	-	-	-	-	+
77	18.04	295.2278 **[M-H]**$^-$	3.315	$C_{18}H_{31}O_3^-$	**277**, 267, 251	Hydroxyoctadecadienoic acid	Fatty acid	-	-	-	-	+
78	18.08	520.3401 **[M+H]**$^+$	0.316	$C_{26}H_{51}NO_7P^+$	**502,** 258, 184	Lysophosphatidylcholine (18:2) LYSO-PC	Phospholipid	+	-	+	+	-
79	18.3	293.2122 **[M-H]**$^-$	3.546	$C_{18}H_{29}O_3^-$	275, **249**, 221	Oxo-octadecadienoic acid	Fatty acid	-	-	-	-	+
80	18.35	454.2928 **[M+H]**$^+$	1.33	$C_{21}H_{45}NO_7P^+$	**436**, 313	Lysophosphatidyl ethanolamine (16:0)	Phospholipid	-	-	+	+	-

Peak No.	R_t (min.)	Mol. ion *m/z* [-/+]	Error (ppm)	Formula	MS/MS fragments	Tentative Identification	Class	TE	BU	EA	CH	PE
81	18.57	385.2372 **[M+H]**$^+$	0.327	$C_{24}H_{33}O_4^+$	**367,** 349, 321, 255, 193, 175	Cinnamoyl epoxy guaiandiol	Sesquiterpene	-	-	-	+	+
82	18.67	496.3 **[M+H]**$^+$	1.076	$C_{24}H_{51}NO_7P^+$	**478,** 258, 184	Lysophosphatidylcholine (16:0) LYSO-PC	Phospholipid	-	-	+	+	-
83	18.8	279.1591 **[M+H]**$^+$	1.949	$C_{16}H_{23}O_4^+$	205, **149**	Dibutyl phthalate	Phthalate	+	-	+	+	+
84	19.05	522.3553 **[M+H]**$^+$	1.176	$C_{26}H_{53}NO_7P^+$	**504,** 258, 184	Lysophosphatidylcholine (18:1) LYSO-PC	Phospholipids	+	-	+	+	-
85	19.51	353.2682 **[M+H]**$^+$	1.348	$C_{21}H_{37}O_4^+$	335, **261**	Octadecatrienoylglycerol	Mono glyceride	+	-	+	+	+
86	19.83	293.2469 **[M+H]**$^+$	2.001	$C_{19}H_{33}O_2^+$	**261**, 243, 237, 223, 179, 165, 151	Methyl octadeca-trienoate	Fatty acid	-	-	-	+	+
87	20.4	524.3472 **[M+H]**$^+$	1.098	$C_{26}H_{55}NO_7P^+$	**506,** 258, 184	Lysophosphatidylcholine (18:0) LYSO-PC	Phospholipid	-	-	+	+	-
88	20.77	311.2578 **[M+H]**$^+$	0.744	$C_{19}H_{35}O_3^+$	293, **279**, 261, 243, 219, 183	Methyl-hydroxy-octadecadienoate	Fatty acid	-	-	+	+	+
89	21.07	282.2788 **[M+H]**$^+$	1.841	$C_{18}H_{36}NO^+$	**265**, 247	Octadecenamide (oleamide)	Amide	-	-	-	+	+
90	21.42	513.3574 **[M+H]**$^+$	0.061	$C_{32}H_{49}O_5^+$	495, 471, 453, 435, **407**, 307, 233, 219, 173	Acetoxy-oxo-olean-enoic acid	Triterpene	-	-	-	+	+
91	22.41	307.2627	1.389	$C_{20}H_{35}O_2^+$	289, **261**, 243, 137	Labdane triterpene	Triterpene	-	-	-	+	+
92	22.67	441.3721 **[M+H]**$^+$	1.376	$C_{30}H_{49}O_2^+$	**423**, 405, 287, 233, 215, 189	Hydroxy olean-ene-one (oxo-*β*-amyrin)	Triterpene	-	-	-	-	+
93	22.82	439.3565 **[M+H]**$^+$	1.177	$C_{30}H_{47}O_2^+$	**421**, 411, 381, 287, 233, 215 189	Olean-en-dione	Triterpene	-	-	-	-	+
94	22.93	391.2834 **[M+H]**$^+$	2.367	$C_{24}H_{39}O_4^+$	279, 167, **149**	Bis (ethyl hexyl) phthalate	Phthalate	-	-	+	+	+
95	23.4	338.3421 **[M+H]**$^+$	0.65	$C_{22}H_{44}NO^+$	**321**, 303	Docosenamide	Amide	+	+	+	+	-
96	23.85	483.3839**[M+H]**$^+$	1.32	$C_{32}H_{51}O_3^+$	465, 437, **423**, 405, 345, 287, 277, 233, 215	Oxo-olean-en-yl acetate	Triterpene	-	-	-	-	+
97	25.67	411.3613 **[M+H]**$^+$	3.381	$C_{29}H_{47}O^+$	**393,** 253, 157	Stigmasta-trien-ol	Sterol	-	-	-	+	+
98	25.91	425.3775 **[M+H]**$^+$	0.688	$C_{30}H_{49}O^+$	**407**, 367, 299, 245	Eupha-dien-one	Triterpene	-	-	-	-	+
99	26.47	411.3618 **[M+H]**$^+$	0.857	$C_{29}H_{47}O^+$	393, 353, **275,** 253	Secostigmasta-tetraen-ol	Sterol	-	-	-	+	+

Peak No.	R_t (min.)	Mol. ion *m/z* [-/+]	Error (ppm)	Formula	MS/MS fragments	Tentative Identification	Class	TE	BU	EA	CH	PE
100	26.96	413.3776 **[M+H]**$^+$	0.418	$C_{29}H_{49}O^+$	**395**, 367, 255	Stigmasta-dienol (stigmasterol)	Sterol	-	-	-	-	+

R_t: retention time

TE: Total ethanol extract; BU: Butanol fraction; EA: Ethyl acetate fraction; CH: Chloroform fraction; PE: Petroleum ether fraction

+ and - denotes the presence or absence of a metabolite in the extract or fractions

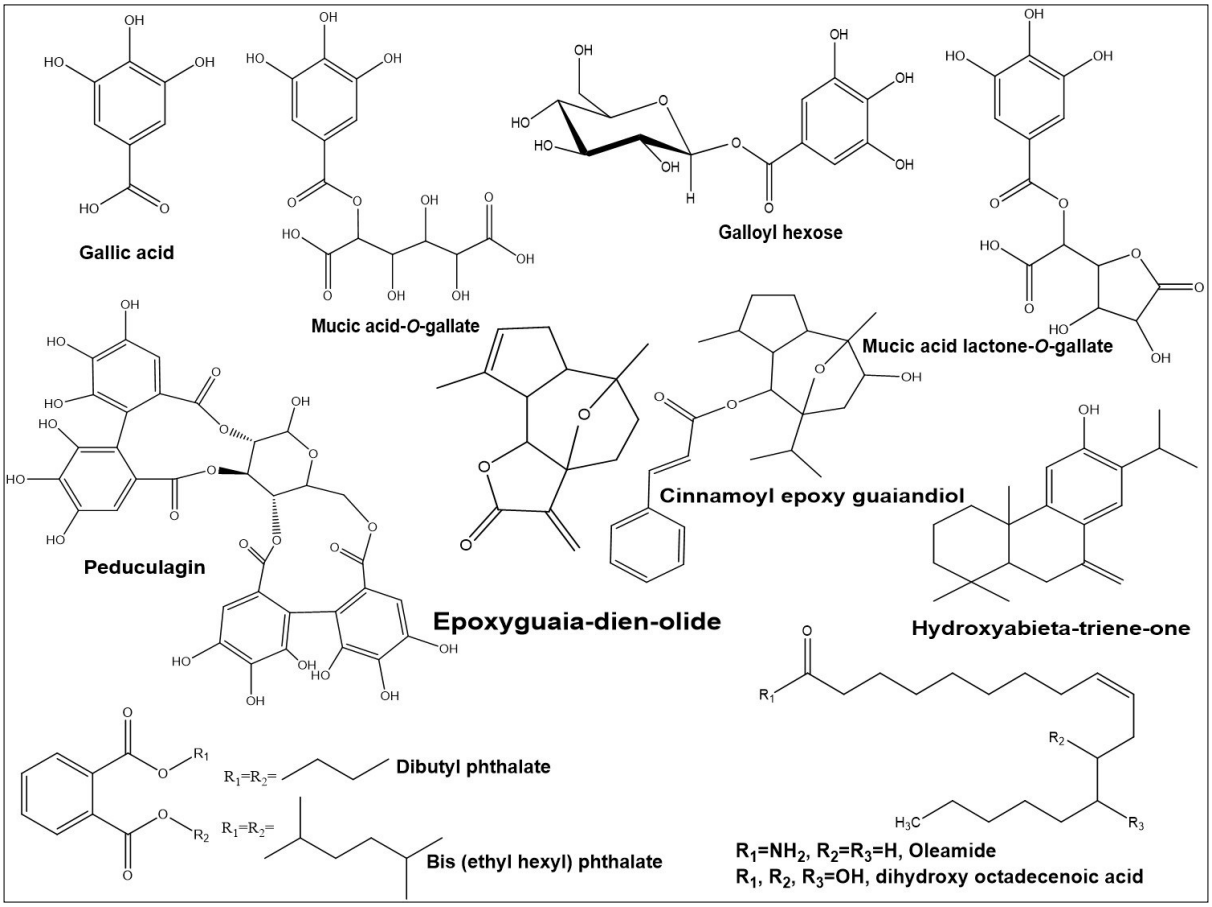

Fig. S6: Structures of the major metabolites identified in *P. emblica* fruit *via* UPLC-MS and discussed in the manuscript

Table S4: Metabolites analyzed via GC-MS from PE and CH fractions of *P. emblica* fruits with results expressed as relative percentile of the total peak area

Peak	RT (min)	KI	Name	Class	PE	CH
			Organic acids			
1	6.55	862.1	Lactic acid, bis-TMS	Organic acid	0.09	0.18
2	6.86	877.2	Glycolic acid, bis-TMS	Organic acid	-	0.18
3	7.10	888.3	Pyruvic acid, enol, di-TMS	Organic acid	-	0.16
4	8.28	1938.3	2-Furoic acid-TMS	Organic acid	0.07	0.14
5	11.23	1056.2	Malic acid, *O*-trimethylsilyl-, dimethyl ester	Organic acid	-	0.13
6	12.45	1103.9	Maleic acid, di-TMS	Organic acid	0.06	0.11
7	12.75	1115.5	Succinic acid, di-TMS	Organic acid	0.33	0.9
8	13.69	1151.9	Fumaric acid, bis-TMS	Organic acid	0.06	0.11
9	16.09	1229.1	Malic acid -3TMS	Organic acid	0.13	10.75
10	19.22	1375.9	α-Hydroxyglutaric acid (3TMS)	Organic acid	-	0.11
11	19.23	1376.2	Suberic acid-2TMS	Organic acid	0.08	-
12	20.64	1437	Tartaric acid, bis-*O*-(trimethylsilyl)-, bis(trimethylsilyl) ester	Organic acid	0.11	-
13	24.17	1596.7	Azelaic acid, bis-TMS	Organic acid	0.46	0.19
14	24.59	1617	Citric acid, tetrakis-TMS	Organic acid	0.18	0.21
15	27.14	1742.7	Ascorbic acid (4TMS)	Organic acid	-	0.25
	Total organic acids (%)				**1.59**	**13.42**
			Sugars			
16	8.01	927.4	Ethylene glycol, bis-trimethylsilyl ether	Sugar alcohol	1.88	2.29
17	11.68	1074	Glycerol, tris-TMS ether	Sugar alcohol	0.33	0.36
18	13.12	1129.9	Glyceric acid-3TMS	Sugar acid	0.17	0.33
19	18.85	1360.2	L-Threonic acid, tris(trimethylsilyl) ether, trimethylsilyl ester	Sugar acid	0.34	0.28
20	22.78	1532.8	D-Xylonic acid, 2,3,5-tris-*O*-(trimethylsilyl)-, *γ*-lactone,	Sugar acid	0.11	0.15
21	24.26	1601.1	D-Fructofuranose, pentakis(trimethylsilyl) ether (isomer 1)	Sugar	1.77	1.03
22	24.47	1611.1	D-Fructofuranose, pentakis(trimethylsilyl) ether (isomer 2)	Sugar	5.52	2.74
23	26.07	1689	D-Galactopyranose, 1,2,3,4,6-pentakis-*O*-(trimethylsilyl)-,	Sugar	0.23	-
24	26.41	1705.7	Gluconic acid, 2,3,5,6-tetrakis-*O*-(trimethylsilyl)-, lactone	Sugar acid	0.84	1.25
25	27.33	1752.5	Unknown sugar	Sugar	0.96	-
26	27.85	1778.6	D-Glucose, penta-TMS	Sugar	0.31	0.24
27	28.21	1796.9	*β*-Galactofuranose, pentakis-TMS	Sugar	1.57	0.43
28	29.06	1840.5	Maltose, octakis(trimethylsilyl) ether, (isomer 1)	Sugar	4.19	3.6
29	29.86	1881.3	Myo-Inositol, 1,2,3,4,5,6-hexakis-*O*-(trimethylsilyl)	Sugar	1.1	1.06

30	38.96	2344.1	Sucrose, octakis (trimethylsilyl) ether	Sugar	0.32	0.2
	Total sugars (%)				**19.65**	**13.98**
			Phenolic compounds			
31	11.05	1049.1	Benzoic acid trimethylsilyl ester	Phenolic compound	0.06	0.11
32	18.62	1350.4	(E)- Cinnamic acid, TMS	Phenolic compound	5.13	3.98
33	20.40	1426.5	*p*-Hydroxybenzoic acid -TMS	Phenolic compound	0.05	_
34	24.94	1633.8	Butanoic acid, 2-methyl-, 2-methoxy-4-(2-propenyl) phenyl ester	Phenolic compound	0.75	_
35	25.96	1683.3	Unknown phenolic	Phenolic compound	0.42	7.51
36	26.95	1733.2	3,4,5-Trihydroxybenzoic acid methyl ester, tris(O-trimethylsilyl)-	Phenolic compound	_	0.6
37	27.41	1756.1	Gallic acid, tetraTMS	Phenolic compound	2.89	7.31
38	29.95	1885.8	Ferulic acid, di-TMS	Phenolic compound	_	0.16
39	42.17	2507.1	Catechin, penta-TMS ether	Phenolic compound	0.16	_
	Total Phenolic compounds (%)				**9.46**	**19.67**
			Phthalides and phthalates			
40	21.15	1459.4	Butylphthalide	Phthalide	6.26	_
41	22.57	1523.2	Senkyunolide (N-butyl-4,5-dihydrophthalide)	Phthalide	4.15	_
42	37.48	2268.7	Bis (2-ethylhexyl) phthalate	Phthalate	3.5	3.95
	Total phthalides and phthalates				**13.91**	**3.95**
			Fatty acids and esters			
43	13.95	1161.9	Nonanoic acid-TMS	Fatty acid	0.08	-
44	16.38	1258.3	Decanoic acid-TMS	Fatty acid	0.08	-
45	18.74	1355.3	Undecanoic acid-TMS	Fatty acid	0.09	-
46	21.01	1453.3	Lauric acid-TMS	Fatty acid	0.41	-
47	25.26	1649.4	Myristic acid-TMS	Fatty acid	0.73	0.15
48	26.86	1728.2	Palmitic acid, methyl ester	Fatty acid ester	6.28	-
49	28.74	1824.1	(Z)-9-Hexadecenoic acid-TMS	Fatty acid	0.32	-
50	28.80	1827.1	Margaric acid, methyl ester	Fatty acid ester	0.2	-
51	29.23	1849.2	Palmitic acid-TMS	Fatty acid	5.97	2.99
52	30.06	1891.2	Linolelaidic acid, methyl ester	Fatty acid ester	_	0.09
53	30.09	1892.5	Linoleic acid, methyl ester	Fatty acid ester	2.27	-
54	30.22	1899.4	Elaidic acid, methyl ester	Fatty acid ester	1.01	-
55	30.42	1911	Oleic acid, methyl ester	Fatty acid ester	0.69	-
56	30.69	1923	Stearic acid, methyl ester	Fatty acid ester	1.02	-
57	30.99	1938.5	Margaric acid-TMS	Fatty acid	1.02	-
58	31.41	1959.9	Unknown fatty acid	Fatty acid	0.66	-

59	32.21	2000.7	Linoleic acid -TMS	Fatty acid	2.85	0.99
60	32.36	2008	Elaidic acid -TMS	Fatty acid	3.69	1.44
61	32.42	2011.1	Oleic acid-TMS	Fatty acid	0.73	0.22
62	32.77	2029	Stearic acid-TMS	Fatty acid	3.89	0.63
63	34.21	2102.1	Arachidic acid, methyl ester	Fatty acid ester	0.11	-
64	36.04	2195.3	Arachidic acid-TMS	Fatty acid	0.53	-
65	37.60	2274.8	Heneicosanoic acid-TMS	Fatty acid	0.22	-
66	38.72	2331.9	(Z)-13-Docosenoic acid-TMS	Fatty acid	0.19	-
67	39.11	2351.5	Behenic acid-TMS	Fatty acid	0.39	0.16
68	41.97	2496.9	lignoceric acid-TMS	Fatty acid	0.23	-
69	42.92	2545.4	*α*-Hydroxylignoceric acid, TMS ether, methyl ester	Fatty acid ester	0.15	-
70	43.33	2566	Pentacosanoic acid-TMS	Fatty acid	0.13	-
71	44.64	2632.8	Hexacosanoic acid-TMS	Fatty acid	0.13	-
	Total fatty acids and esters (%)				**34.07**	**6.86**
			Fatty alcohols			
72	32.64	2022.4	Unknown fatty alcohol	Fatty alcohol	1.63	-
73	43.81	2590.8	Tetracosan-1-ol trimethylsilyl ether	Fatty alcohol	0.23	-
	Total fatty alcohols (%)				**1.86**	-
			Monoglycerides			
74	37.81	2285.4	2-Monopalmitoyl glycerol trimethylsilyl ether	Monoglyceride	0.18	-
75	38.32	2311.1	1-Monopalmitin trimethylsilyl ether	Monoglyceride	1.03	0.34
76	40.80	2437.6	1-Monooleoylglycerol trimethylsilyl ether	Monoglyceride	0.39	-
77	41.15	2455.4	Bis (trimethylsilyl) monostearin	Monoglyceride	0.3	-
	Total monoglycerides (%)				**1.9**	**0.34**
			Terpenes and sterols			
78	22.70	1528.9	Isosericenin	Sesquiterpene	1.24	-
79	22.99	1542.5	*β*-Eudesmol, trimethylsilyl ether	Sesquiterpene	0.88	-
80	34.03	2093.3	Pimaric acid -TMS	Diterpene	0.53	-
81	34.34	2108.7	Isopimaric acid-TMS	Diterpene	0.24	-
82	33.40	2061.1	Unknown sterol	Sterol	1.82	-
83	43.38	2568.7	Unknown sterol-TMS	Sterol	0.6	0.31
84	47.38	2772.1	Campesterol-TMS	Sterol	0.11	-
85	47.75	2791.2	Stigmasterol trimethylsilyl ether	Sterol	0.34	-
86	48.77	2843.1	*β*-Sitosterol trimethylsilyl ether	Sterol	1.66	0.23
87	48.95	2851.8	3-[(Trimethylsilyl) oxy] stigmasta-5,24(28)-diene	Sterol	0.10	
88	49.30	2869.7	(3*β*)- Cholest-5-en-24-one, 3-[(trimethylsilyl) oxy]	Sterol	0.09	-
89	54.59	3139	Unknown sterol	Sterol	0.07	-
90	46.47	2725.7	Unknown terpene	Triterpene	0.12	-
91	47.10	2757.8	Unknown oleanane triterpenes	Triterpene	0.28	0.19
92	48.72	2840.1	Olean-12-en-3-one	Triterpene	1.43	-

93	49.09	2859	Unknown oleanane triterpenes	Triterpene	0.27	-
94	49.93	2901.8	α-Amyrin, trimethylsilyl ether	Triterpene	0.21	-
95	50.49	2930.3	β-Amyrin trimethylsilyl ether	Triterpene	0.08	-
96	50.78	2944.9	(3α)-12-Oleanen-3-yl acetate	Triterpene	0.1	-
97	53.04	3060.1	Unknown triterpenes	Triterpene	0.3	-
98	53.89	3103.5	Lup-20(29)-en-3β-ol, acetate	Triterpene	0.13	-
99	54.26	3121.9	Unknown triterpene	Triterpene	0.25	0.11
100	54.91	3155.1	Unknown triterpenes	Triterpene	0.07	-
	Total terpenes and sterols (%)				**10.93**	**0.84**
			Miscellaneous			
101	7.191	892.9	Ethanolamine, N-trimethylsilyl-, trimethylsilyl ether	Amine	0.64	2.12
102	13.42	1141.5	Ethanolamine, N, N-bis (trimethylsilyl)-, trimethylsilyl ether	Amine	-	0.25
103	11.62	1071.4	Phosphoric acid, triTMS	Inorganic acid	0.37	0.71
104	17.85	1318.1	Pyroglutamic acid, bis (trimethylsilyl)	Amino acid	0.21	15.13
105	17.52	1304.3	Pentonic acid, 2-deoxy-3,5-bis-*O*-(trimethylsilyl)-, γ-lactone	Lactone	0.21	-
106	20.53	1432.2	2,3,4,5-Tetrahydroxypentanoic acid-1,4-lactone, tris(trimethylsilyl)	Lactone	0.28	-
107	31.91	1985.5	1-Docosene	Hydrocarbon	0.28	-
	Total Miscellaneous (%)				**2.0**	**18.22**
			Unknowns			
108	5.7	821.4	Unknown	Unknown	0.25	0.36
109	12.10	1090.4	Unknown	Unknown	-	0.30
110	14.12	1168.5	Unknown	Unknown	-	15.2
111	14.61	1187.8	Unknown	Unknown	-	2.97
112	16.63	1268.4	Unknown	Unknown	-	2.09
113	18.18	1331.9	Unknown	Unknown	0.4	0.31
114	22.92	1539.4	Unknown	Unknown	0.83	1.02
115	26.89	1730.1	Unknown	Unknown	-	0.47
116	28.67	1820.7	Unknown	Unknown	-	-
117	30.57	1917.3	Unknown	Unknown	0.36	-
118	41.62	2479.2	Unknown	Unknown	0.39	-
119	53.64	3090.7	Unknown	Unknown	0.19	-
	Total Unknowns (%)				**4.62**	**22.72**
	Total metabolites (%)				**99.99**	**100**

KI: Kovats retention index.; RT: Retention time.

-: absent

PE: Petroleum ether fraction; CH: Chloroform fraction; TMS: Trimethylsilyl

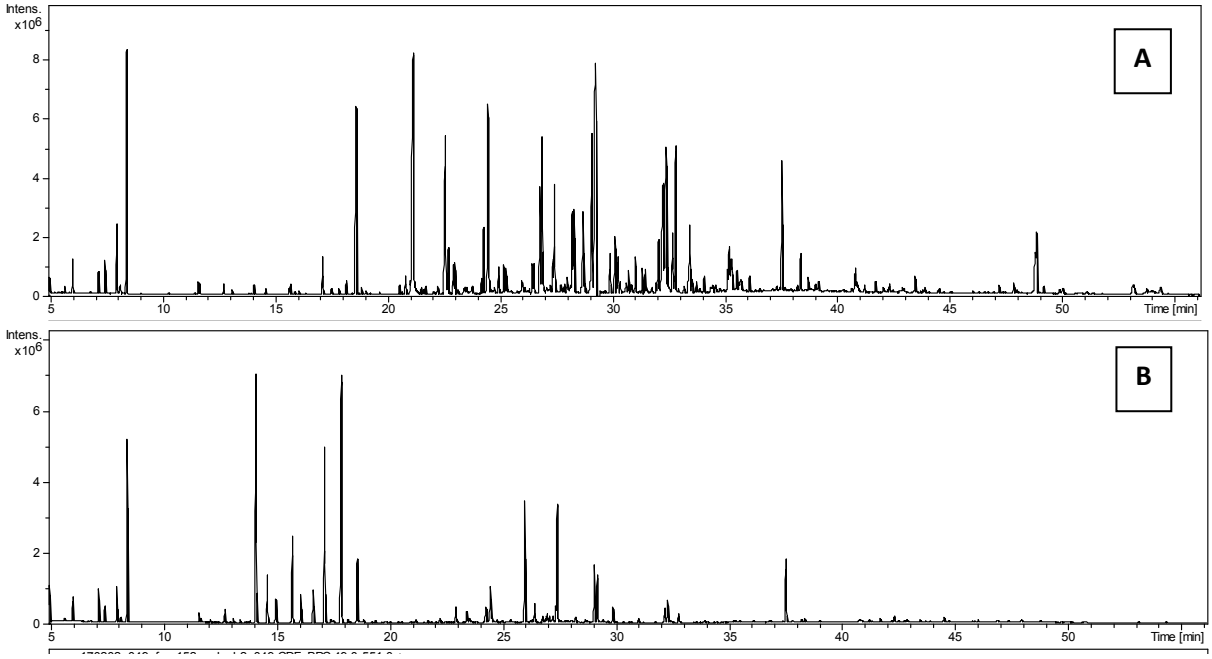

Fig. S7: Representative GC/MS chromatogram analysis of silylated metabolites in: **(A)**: PE fraction; **(B)**: CH fraction of *P. emblica* fruit.