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(2)

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Stability of Steroid Profiles (3): Ratios and Excretion Rates of Endogenous Steroids in female
Urines Collected four Times over 24 Hours
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Stability of Steroid Profiles (4): The Circadian Rhythm of Urinary Ratios and Excretion Rates of Endogenous Steroids in Female and its Menstrual Dependency

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The stability of ratios and excretion rates of endogenous steroids in female urines was investigated. Four female (age: $x=33\pm 1.4$ years) volunteers participated. Urine samples were collected over a 24 hour period on four different days during a given month.

The urines were prepared according to the screening procedure of conjugated anabolic steroids and analysed by GC/MS (1).

The following steroid glucuronides were measured and quantified: androsterone (A), etiocholanolone (E), testosterone (T), epitestosterone (epiT), 11 β -OH-androsterone (OHA), 11 β -OH-etiocholanolone (OHE), 5 α -androstan-3 α ,17 β -diol (Adiol), 5 β -androstan-3 α ,17 β -diol (Bdiol), pregnandiol (Pregnd) and tetrahydrocortisol (THF).

The results of selected steroid concentration ratios, their excretion rates and statistical evaluations are shown in Tables 1-9 and Figures 1-10 .

References

- (1) Donike M., Geyer H., Gotzmann A., Kraft M., Mandel F., Nolteernsting E., Opfermann G., Sigmung G., Schänzer W. and Zimmermann J.: Dope Analysis
In: Official Proceedings of the International Athletic Foundation World Symposium on Doping in Sport. P.Bellotti, G.Benzi, A.Ljungquist (Hrsg.) IAAF Florence (1988) 53-87.
- (2) Mareck-Engelke U., Geyer H. and Donike M.: Stability of steroid profiles
In: 10th Cologne Workshop On Dope Analysis, 7th To 12th June 1992 -Proceedings-, 87-89
- (3) Mareck-Engelke U., Geyer H. and Donike M.: Stability of steroid profiles (2) :
Excretion rates from morning urines In: Recent Advances In Doping Analysis
Proceedings of the 11th Cologne Workshop On Dope Analysis, 7th to 12th March 1993 ,85-89
- (3) Mareck-Engelke U., Geyer H. and Donike M.: Stability of steroid profiles (3) :
The Circadian Rhythm of Urinary Ratios and Excretion Rates of Endogenous Steroids in Male
(In Press)

Conclusions

The ratio A/E is the most stable parameter.

Ratios with T and epiT show much more variation. The concentrations of testosterone and epitestosterone are near the detection limit and frequently other endogenous substances coelute with them. (tab 1,2,6).

The ratios Adiol/Bdiol, A/Adiol, A/Bdiol, E/Adiol and E/Bdiol show coefficients of variation less than 30% (except for one volunteer) (tab 1; fig 2).

The excretion rates of the endogenous steroids show strong intraindividual and interindividual variation (tab 3,4,5).

Maximum excretion rates were observed at daytime hours, minima at nighttime hours.

Maxima were stronger marked than minima.

Calculated were differences between excretion rates of all quantified steroids (max. and min.) and their corresponding mean values.

The calculated values for all steroids from all volunteers are presented in tab 8 and 9.

They are situated in a range characterised as: " mean \pm 2.9 * st.dev."

These data are based on 48 data points per person and steroid.

The boarderlines of the subject-based reference ranges for persons under resting conditions within 4 times 24 hours (for n=48) may be defined as: $L_0 = \text{mean} \pm 3.0 * \text{st.dev.}$

The calculation factor t depends on the number of analysed and calculated samples from one individual. Decrease of sample numbers will lead to an increase of the calculation factor.

In the present study involving female urines there are big variations between day and nighttime values for the three parameters 11OHA, THF and 11OHA/11OHE (tab 7).

For all volunteers, in 13 of 16 days of the female menstrual cycle the ratio 11OHA/11OHE decreases significantly during the night. In three cases no significant difference is recognizable (tab 7; fig.3).

The excretion of 11OHA decreases significantly during the night for all volunteers in 13 of 16 days of the female menstrual cycle. In three cases no significant difference is recognizable (tab 7; fig 4).

Also the excretion of THF decreases significantly during the night for all volunteers in 15 of 16 days of the female menstrual cycle. Only in one case no significant difference is recognizable (tab 7; fig. 5).

The circadianic excretion character of 11OHA and THF depends on the rhythm of ACTH.

For all other steroids no common circadianic rhythm is recognizable.

In the similar study (4), all male volunteers show significant decreases of excretion rates for 11OHA and THF and the ratio 11OHA/11OHE at nighttime hours.

There is no individual connection recognizable between the day of the female menstrual cycle and the type of significance difference.

Similar to the male study it was confirmed that for steroids with small variation in excretion during 24 hours (A,E, Adiol, Bdiol) a small urine collecting interval (only a few hours or a morning urine) is representative for a 24 hour collected urine (fig 8).

For steroids with a large variation in excretion during 24 hours (steroids following the ACTH-rhythm: THF, OHA) this should not be practiced (fig 9).

There is no interindividual and intraindividual connection recognizable between the day of the female menstrual cycle and the examined excretion rates or ratios.

There is no correlation between excretion of endogenous steroids and flow of urine (fig 10).

Table 1: Stability of steroid profiles (female urines).

Coefficient of variation (%) of some selected steroid concentration ratios

V1-V4 = volunteer 1-4

day (m.c.) = day of female menstrual cycle

Total = Statistical evaluation of all values from one volunteer

day (m.c.)	V1					V2				
	2	7	14	21	Total	2	7	13	21	Total
A/E	10	7	12	6	18	10	9	8	4	16
T/epiT	53	12	39	57	66	71	42	50	31	68
A/T	16	17	26	30	31	77	30	60	33	108
A/epiT	35	17	33	34	62	66	17	11	5	100
Adiol/Bdiol	11	7	6	3	19	14	10	10	6	16
A/Adiol	13	14	18	15	17	9	15	7	9	16
A/Bdiol	15	10	15	15	18	20	15	13	13	23
E/Adiol	15	13	12	15	16	6	18	11	10	16
E/Bdiol	15	11	15	14	25	15	12	13	14	14
OHA/OHE	33	39	53	60	60	33	47	47	43	54
A/THF	34	49	37	45	64	34	25	28	27	38

day (m.c.)	V3					V4				
	2	9	13	20	Total	2	9	15	21	Total
A/E	7	7	8	13	19	15	11	8	9	10
T/epiT	79	28	28	55	63	22	25	23	21	49
A/T	14	22	17	35	24	10	25	25	18	21
A/epiT	79	13	17	52	61	19	23	11	24	54
Adiol/Bdiol	28	37	26	18	49	21	10	12	10	16
A/Adiol	18	25	20	26	30	13	25	14	10	18
A/Bdiol	21	17	23	26	61	14	24	13	11	20
E/Adiol	17	27	16	18	28	17	24	20	12	19
E/Bdiol	18	15	19	20	49	15	22	16	17	20
OHA/OHE	59	62	56	47	60	33	37	55	54	59
A/THF	65	49	36	56	68	51	29	24	43	53

Table 2: Stability of steroid profiles (female urines).

Statistics of some selected steroid concentration ratios

(min = minimum value; max = maximum value;

st.dev. = standard deviation; c.v. = coefficient of variation (%).

V1-V4 = volunteer 1-4 day (m.c.) = day of female menstrual cycle

Total = Statistical evaluation of all values from one volunteer

day (m.c.)	V1					V2				
	2	7	14	21	Total	2	7	13	21	Total
<u>A/E</u>										
min	0.91	0.83	1.07	1.27	0.83	0.71	0.54	0.68	0.86	0.53
max	1.23	1.00	1.41	1.53	1.53	0.97	0.69	0.90	0.98	0.98
mean	1.09	0.90	1.18	1.40	1.13	0.83	0.62	0.78	0.92	0.78
st.dev.	0.11	0.06	0.14	0.09	0.21	0.08	0.05	0.06	0.04	0.13
c.v.(%)	10	7	12	6	18	10	9	8	4	16
<u>T/epiT</u>										
min	1.19	1.50	1.60	1.73	1.19	0.09	0.14	0.14	0.24	0.06
max	4.95	2.19	6.32	12.6	12.6	1.26	0.40	0.60	0.57	1.26
mean	2.58	1.88	4.34	5.75	3.61	0.55	0.21	0.36	0.39	0.37
st.dev.	1.36	0.23	1.68	3.28	2.39	0.39	0.09	0.18	0.12	0.26
c.v.(%)	53	12	39	57	66	71	42	50	31	68

day (m.c.)	V3					V4				
	2	9	13	20	Total	2	9	15	21	Total
<u>A/E</u>										
min	0.43	0.47	0.62	0.51	0.37	0.52	0.59	0.59	0.56	0.52
max	0.55	0.59	0.77	0.82	0.82	0.78	0.82	0.75	0.73	0.82
mean	0.51	0.51	0.70	0.73	0.60	0.66	0.69	0.65	0.65	0.66
st.dev.	0.04	0.04	0.05	0.09	0.11	0.10	0.08	0.06	0.06	0.07
c.v.(%)	7	7	8	13	19	15	11	8	9	10
<u>T/epiT</u>										
min	1.41	0.97	0.97	1.29	0.97	1.04	0.95	0.63	0.56	0.56
max	8.16	2.16	2.34	6.72	8.16	2.40	2.21	1.19	1.30	4.67
mean	2.93	1.47	1.63	3.61	2.43	1.93	1.54	0.92	0.97	1.45
st.dev.	2.31	0.41	0.46	1.99	1.54	0.43	0.38	0.21	0.21	0.70
c.v.(%)	79	28	28	55	63	22	25	23	21	49

Table 3: Stability of steroid profiles (female urines).

Coefficient of variation (%) of excretion rates

V1-V4 = volunteer 1-4

day (m.c.) = day of female menstrual cycle

Total = Statistical evaluation of all values from one volunteer

day (m.c.)	V1					V2				
	2	7	14	21	Total	2	7	13	21	Total
A	23	26	32	28	27	22	29	29	39	39
E	25	30	35	29	34	27	28	27	42	38
epiT	52	32	67	76	73	71	39	31	42	56
T	19	37	40	28	41	117	27	37	35	53
Adiol	18	24	26	21	26	26	26	27	38	37
Bdiol	19	22	22	21	20	36	26	20	40	39
OHA	55	57	64	64	85	51	53	50	50	57
OHE	33	30	35	19	36	27	28	25	31	35
Pregnd	20	37	29	22	27	31	26	21	26	32
THF	60	55	65	56	104	41	51	54	46	62

day (m.c.)	V3					V4				
	2	9	13	20	Total	2	9	15	21	Total
A	24	25	24	22	40	69	17	20	20	41
E	24	25	24	27	52	59	22	21	20	37
epiT	56	34	43	99	64	64	46	17	51	54
T	20	13	19	42	44	73	25	21	23	42
Adiol	23	23	21	39	78	69	24	23	20	39
Bdiol	28	28	44	51	112	58	23	16	17	32
OHA	52	54	53	53	51	87	49	38	38	61
OHE	41	24	26	48	76	63	22	33	31	42
Pregnd	25	24	28	30	69	62	17	20	34	83
THF	60	70	56	69	64	81	47	35	45	54

Table 4: Stability of steroid profiles (female urines).

Statistics of some selected excretion rates

(min = minimum value; max = maximum value;

st.dev. = standard deviation; c.v. = coefficient of variation (%).

V1-V4 = volunteer 1-4 day (m.c.) = day of female menstrual cycle

Total = Statistical evaluation of all values from one volunteer

day (m.c.)	V1					V2				
	2	7	14	21	Total	2	7	13	21	Total
<u>A</u>										
min	39	38	28	33	28	52	54	64	78	52
max	83	74	62	73	83	105	130	141	223	223
mean	55	49	42	50	50	70	94	98	128	99
st.dev.	12	13	13	14	13	16	27	29	50	39
c.v.(%)	23	26	32	28	27	22	29	29	39	39
<u>E</u>										
min	39	39	20	24	20	61	93	89	80	61
max	83	88	57	54	88	143	212	181	265	265
mean	55	56	36	36	46	87	154	128	142	128
st.dev.	12	17	13	10	16	24	43	35	60	49
c.v.(%)	23	30	35	29	34	27	28	27	42	38
<u>epiT</u>										
min	0.06	0.05	0.02	0.01	0.01	0.03	0.29	0.30	0.21	0.03
max	0.26	0.16	0.08	0.12	0.26	0.34	1.01	0.66	0.67	1.01
mean	0.13	0.10	0.04	0.04	0.08	0.15	0.55	0.44	0.35	0.37
st.dev.	0.07	0.03	0.03	0.03	0.06	0.11	0.21	0.14	0.15	0.21
c.v.(%)	52	32	67	76	73	71	39	31	42	56
<u>T</u>										
min	0.21	0.12	0.09	0.11	0.09	0.01	0.07	0.08	0.05	0.01
max	0.38	0.34	0.24	0.28	0.38	0.29	0.17	0.22	0.20	0.29
mean	0.30	0.18	0.14	0.18	0.21	0.07	0.11	0.14	0.12	0.11
st.dev.	0.06	0.07	0.06	0.05	0.09	0.08	0.03	0.05	0.04	0.06
c.v.(%)	19	37	40	28	41	117	27	37	35	53

day (m.c.)	V3					V4				
	2	9	13	20	Total	2	9	15	21	Total
<u>A</u>										
min	17	31	27	28	17	30	89	63	81	30
max	45	65	58	63	129	345	155	122	152	345
mean	31	40	40	43	40	116	125	85	119	111
st.dev.	7	10	10	9	16	80	21	17	23	45
c.v.(%)	24	25	24	22	40	69	17	20	20	41
<u>E</u>										
min	31	59	43	46	31	41	132	98	126	41
max	87	122	88	105	287	441	262	199	238	441
mean	60	78	58	66	70	175	185	132	183	169
st.dev.	15	19	14	18	36	103	41	28	37	62
c.v.(%)	24	25	24	27	52	59	22	21	20	37
<u>epiT</u>										
min	0.03	0.13	0.07	0.04	0.03	0.06	0.33	0.58	0.48	0.06
max	0.23	0.35	0.32	0.51	0.51	1.07	1.29	1.05	2.29	2.29
mean	0.12	0.20	0.15	0.13	0.16	0.41	0.56	0.74	0.92	0.66
st.dev.	0.07	0.07	0.06	0.13	0.10	0.26	0.26	0.13	0.47	0.35
c.v.(%)	56	34	43	99	64	64	46	17	51	54
<u>T</u>										
min	0.15	0.24	0.17	0.16	0.15	0.24	0.58	0.45	0.58	0.24
max	0.33	0.36	0.31	0.65	0.96	2.57	1.23	0.93	1.28	2.57
mean	0.24	0.30	0.24	0.33	0.29	0.83	0.83	0.72	0.86	0.81
st.dev.	0.05	0.04	0.04	0.14	0.13	0.61	0.21	0.15	0.20	0.34
c.v.(%)	20	13	19	42	44	73	25	21	23	42

Table 5: Stability of steroid profiles (female urines).

Statistical evaluation of excretion rates from all volunteers

min = minimum value

max = maximum value

st.dev. = standard deviation

c.v. = coefficient of variation (%)

	A	E	epiT	T	Adiol	Bdiol	11OHA	11OHE	Pregnd	THF
min (µg/h)	17	20	0.01	0.01	0.24	0.89	1.7	1.1	5.7	5.7
max (")	345	441	2.3	2.6	3.4	38	100	65	292	391
mean (")	76	107	0.33	0.37	0.91	4.5	17	13	37	66
st.dev.	45	66	0.31	0.34	0.53	4.2	13	9.0	43	66
c.v.(%)	59	62	94	92	58	94	75	71	118	100

Table 6: Stability of steroid profiles (female urines).

Statistical evaluation of selected ratios from all volunteers

min = minimum value

max = maximum value

st.dev. = standard deviation

c.v. = coefficient of variation (%)

	A/E	T/epiT	A/T	A/epiT	Adiol/ Bdiol	A/Adiol	A/Bdiol	E/Adiol	E/Bdiol	OHA/ OHE	A/THF
min (µg/h)	0.4	0.06	81	55	0.06	33	2.5	48	6.9	0.3	0.3
max (")	1.5	13	9167	2387	0.9	153	74	234	86	8.5	7.9
mean (")	0.8	1.9	460	428	0.3	86	25	119	32	1.8	1.9
st.dev.	0.2	1.8	852	420	0.2	20	16	39	18	1.4	1.5
c.v.(%)	30	96	185	98	68	23	64	33	57	76	77

Table 7: Stability of steroid profiles (female urines).

Statistical comparison (T-test) of daytime hours and nighttime hours
 Urines, collected over 24 hours at four different times
 (different days of the female menstrual cycle)

day (m.c.) day of female menstrual cycle
 - no significant changes
 ls low significant (95%)
 s significant (99%)
 hs high significant (99,9%)

	11OHA (excretion)	THF (excretion)	11OHA/11OHE
volunteer 1			
2. day m.c.	s	ls	hs
7. day m.c.	ls	hs	-
14. day m.c.	-	-	ls
21. day m.c.	s	s	s
volunteer 2			
2. day m.c.	hs	s	ls
7. day m.c.	hs	hs	s
14. day m.c.	hs	hs	hs
21. day m.c.	-	s	-
volunteer 3			
2. day m.c.	hs	hs	hs
7. day m.c.	hs	hs	hs
14. day m.c.	hs	hs	hs
21. day m.c.	-	s	hs
volunteer 4			
2. day m.c.	hs	hs	hs
7. day m.c.	hs	hs	hs
14. day m.c.	s	s	-
21. day m.c.	hs	s	s

Table 8: Calculation factor (t) for the upper boarderline (u_0) of the subject-based reference range following the formula: $u_0 = \text{mean} + t * \text{st.dev.}$

V1-V4 = volunteer 1-4

day (m.c.) = day of female menstrual cycle

day (m.c.)	V1					V2				
	2	7	14	21	mean	2	7	14	21	mean
A	2.2	1.9	1.6	1.7	1.8	2.2	1.3	1.5	1.9	1.7
E	2.3	1.9	1.7	1.8	1.9	2.4	1.3	1.5	2.0	1.8
epiT	1.8	2.2	1.5	2.4	2.0	1.7	2.1	1.5	2.2	1.9
T	1.2	2.3	1.9	2.1	1.9	2.9	1.7	1.2	2.1	2.0
Adiol	1.5	2.2	1.6	1.4	1.7	2.3	1.1	1.7	1.7	1.7
Bdiol	1.4	2.2	1.5	1.4	1.6	2.1	1.7	1.7	1.7	1.8
OHA	2.2	1.8	1.8	2.1	2.0	1.6	1.1	1.7	2.2	1.6
OHE	1.6	2.0	2.0	1.3	1.7	1.8	1.9	1.3	1.4	1.6
Pregnd	1.7	2.2	1.8	1.7	1.8	2.3	1.2	1.6	1.7	1.7
THF	2.1	1.5	2.0	1.9	1.9	2.1	1.3	1.7	2.4	1.9
mean	1.8	2.0	1.7	1.8	1.8	2.1	1.5	1.5	1.9	1.8

day (m.c.)	V3					V4				
	2	7	14	21	mean	2	7	14	21	mean
A	1.9	2.5	2.0	2.1	2.1	2.8	1.4	2.1	1.4	2.0
E	1.9	2.3	2.2	2.2	2.1	2.6	1.9	2.3	1.5	2.1
epiT	1.8	2.1	2.6	2.9	2.4	2.5	2.8	2.4	2.9	2.7
T	1.8	1.3	1.6	2.3	1.8	2.9	1.9	1.5	2.2	2.1
Adiol	1.6	2.2	1.8	1.6	1.8	2.9	2.0	1.8	1.6	2.0
Bdiol	1.2	1.8	2.7	2.4	2.0	2.5	1.3	2.0	1.6	1.9
OHA	2.1	1.9	1.6	1.9	1.8	2.7	1.7	1.5	1.8	1.9
OHE	1.5	1.3	2.1	2.1	1.7	2.4	1.7	1.6	2.0	1.9
Pregnd	1.1	1.7	2.3	1.5	1.6	2.5	1.2	1.6	2.0	1.8
THF	2.0	1.8	1.5	1.9	1.8	2.3	1.7	1.6	1.6	1.8
mean	1.7	1.9	2.0	2.1	1.9	2.6	1.8	1.8	1.9	2.0

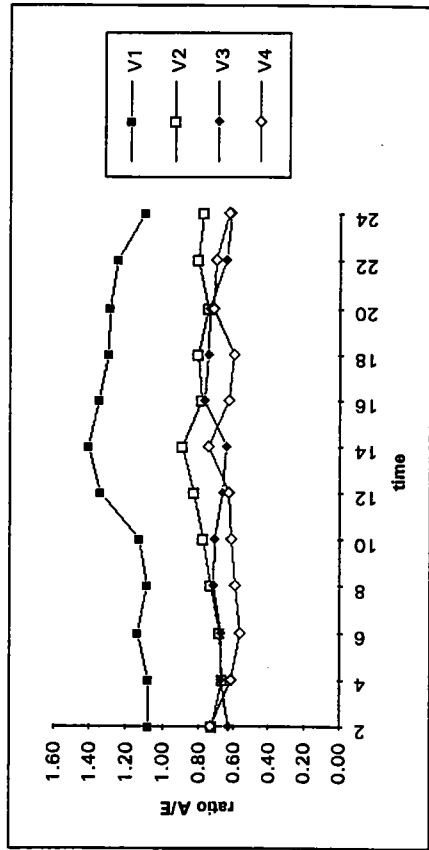
Table 9: Calculation factor (t) for the lower boarderline (l_0) of the subject-based reference range following the formula: $l_0 = \text{mean} + t * \text{st.dev.}$

V1-V4 = volunteer 1-4

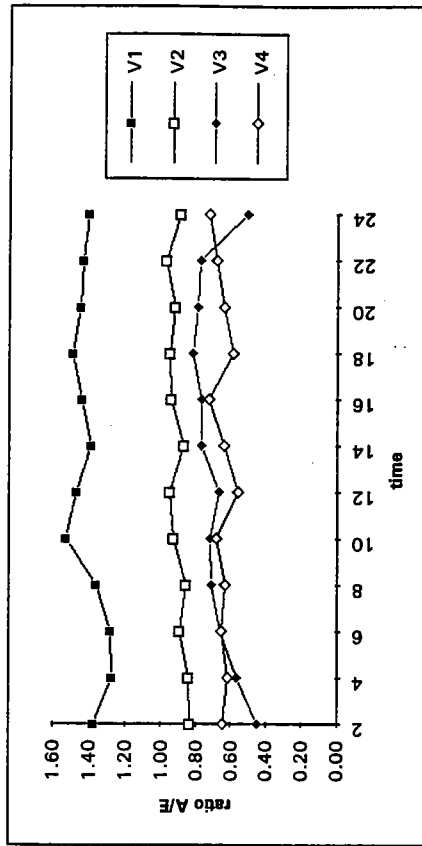
day (m.c.) = day of female menstrual cycle

day (m.c.)	V1					V2				
	2	7	14	21	mean	2	7	14	21	mean
A	1.3	0.9	1.0	1.2	1.1	1.2	1.5	1.2	1.0	1.2
E	0.9	1.0	1.2	1.2	1.1	1.1	1.4	1.1	1.0	1.2
epiT	1.0	1.4	0.9	0.8	1.0	0.9	1.2	1.1	1.0	1.0
T	1.6	1.0	0.8	1.3	1.2	0.8	1.3	1.2	1.7	1.3
Adiol	1.4	1.2	1.7	1.4	1.4	1.2	1.6	1.2	1.2	1.3
Bdiol	1.3	1.0	1.7	1.3	1.3	1.1	1.3	1.2	1.2	1.2
OHA	1.4	1.1	0.9	1.0	1.1	1.2	1.2	1.3	0.9	1.2
OHE	1.8	1.1	1.1	1.6	1.4	1.1	1.7	1.3	1.3	1.3
Pregnd	1.3	1.1	1.3	1.3	1.2	1.3	1.4	1.4	1.4	1.3
THF	1.2	1.2	0.9	1.1	1.1	1.5	1.2	1.1	1.2	1.2
mean	1.3	1.1	1.2	1.2	1.2	1.1	1.4	1.2	1.2	1.2

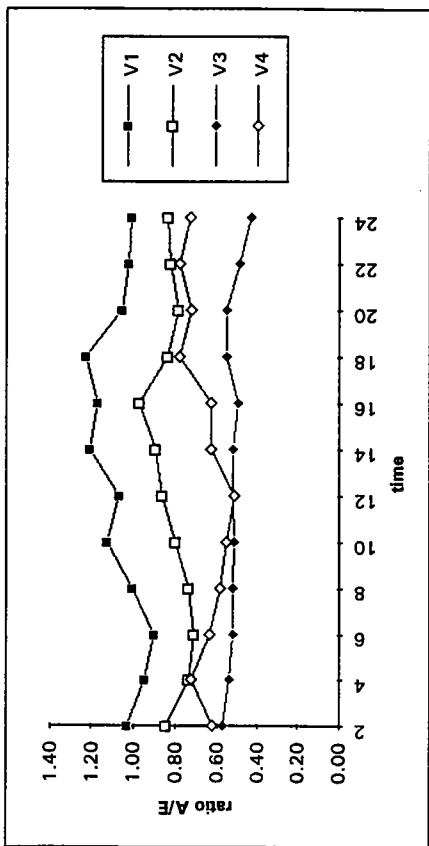
day (m.c.)	V3					V4				
	2	7	14	21	mean	2	7	14	21	mean
A	1.9	0.9	1.3	1.6	1.4	1.1	1.7	1.3	1.6	1.4
E	2.0	1.0	1.1	1.1	1.3	1.3	1.3	1.2	1.5	1.3
epiT	0.9	1.0	1.2	0.7	0.9	1.3	0.9	1.3	0.9	1.1
T	1.9	1.5	1.5	1.2	1.5	1.0	1.2	1.8	1.4	1.4
Adiol	2.0	1.0	1.4	1.1	1.4	1.2	1.3	1.3	1.6	1.4
Bdiol	1.8	1.1	1.0	1.2	1.3	1.3	1.5	1.8	1.8	1.6
OHA	1.3	1.1	1.3	1.2	1.2	1.0	1.3	1.6	1.1	1.3
OHE	1.6	1.8	1.0	0.9	1.3	1.2	1.8	1.5	1.2	1.4
Pregnd	2.1	1.4	1.0	1.3	1.4	1.2	1.7	1.4	1.7	1.5
THF	1.2	1.0	1.3	1.1	1.2	1.0	1.3	1.5	0.9	1.2
mean	1.7	1.2	1.2	1.1	1.3	1.2	1.4	1.5	1.4	1.4



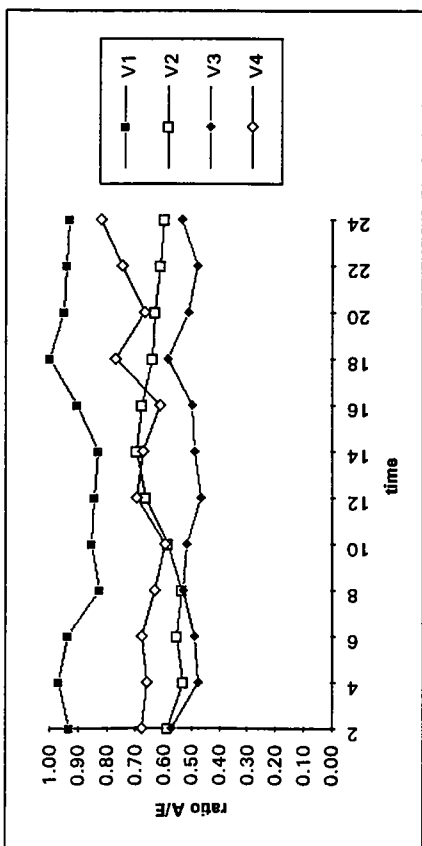
14th day of menstrual cycle



21th day of menstrual cycle



2nd day of menstrual cycle



7th day of menstrual cycle

fig 1: ratio (concentration) A/E in female urine, collected over 24 hours at four different times (different days of the female menstrual cycle) V1-V4 = volunteer 1-4

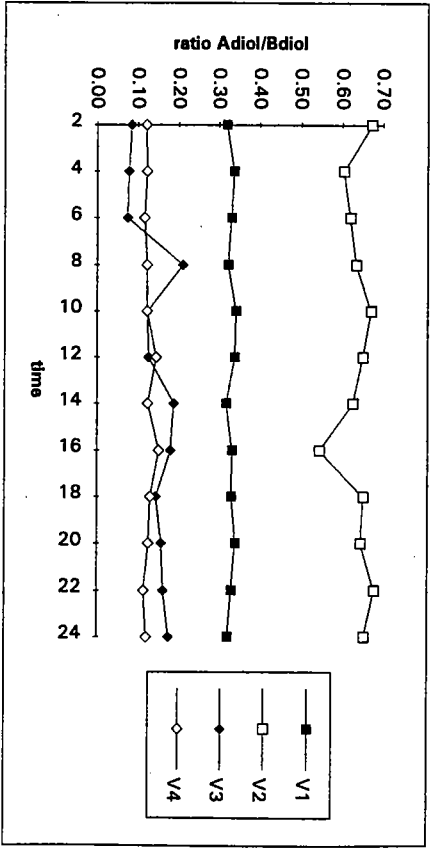
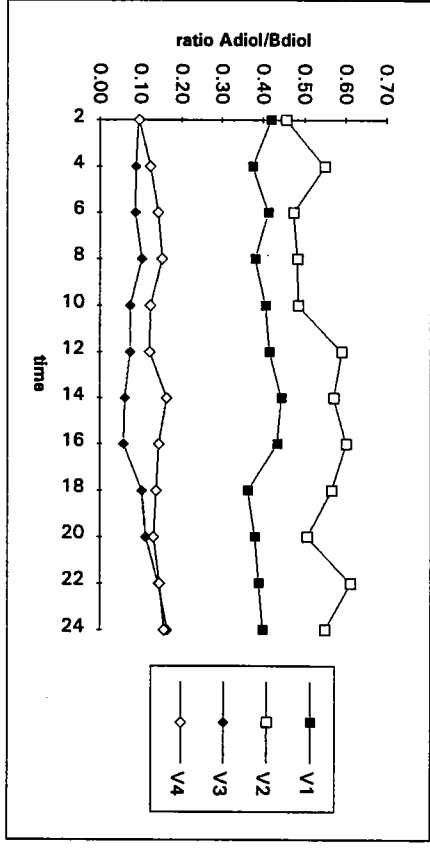
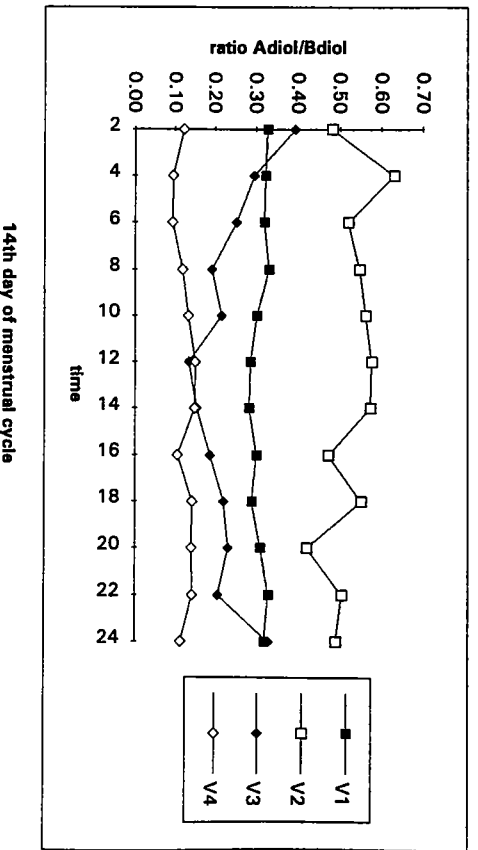
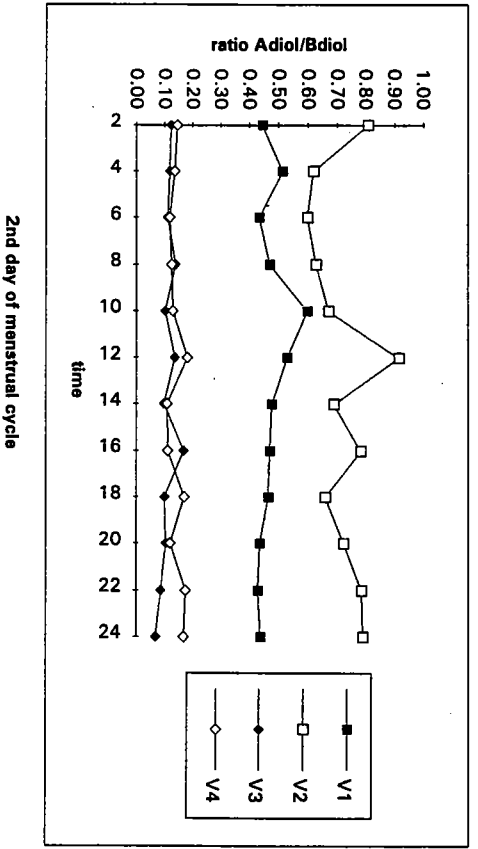


fig 2: ratio (concentration) Adiol/Bdiol in female urine, collected over 24 hours at four different times (different days of the female menstrual cycle) V1-V4 = volunteer 1-4

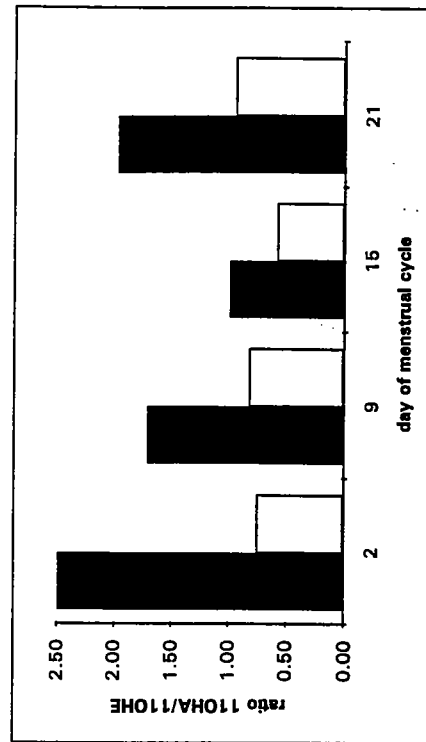
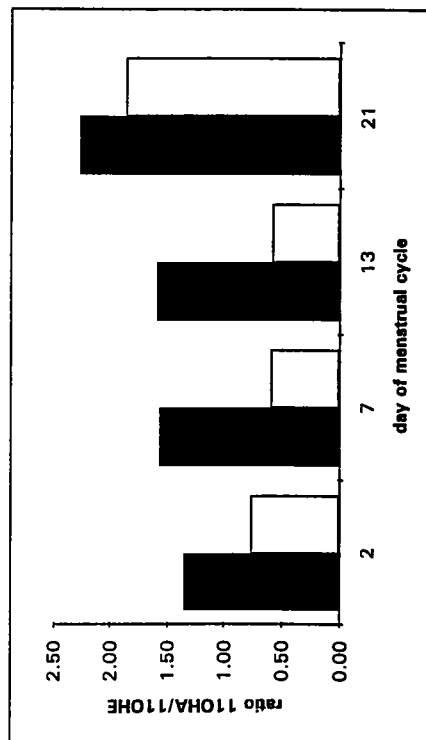
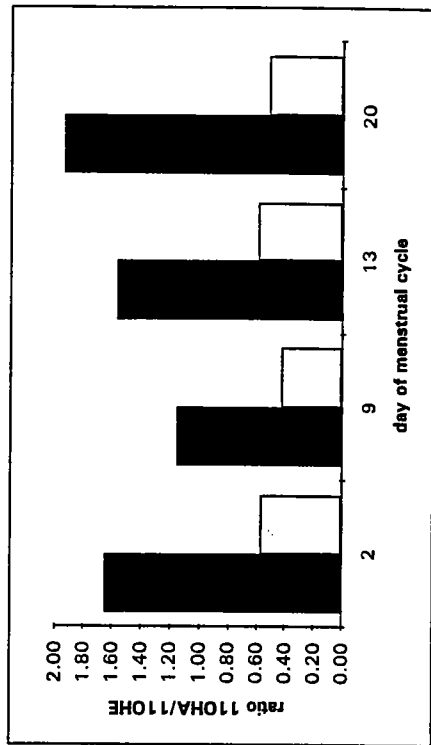
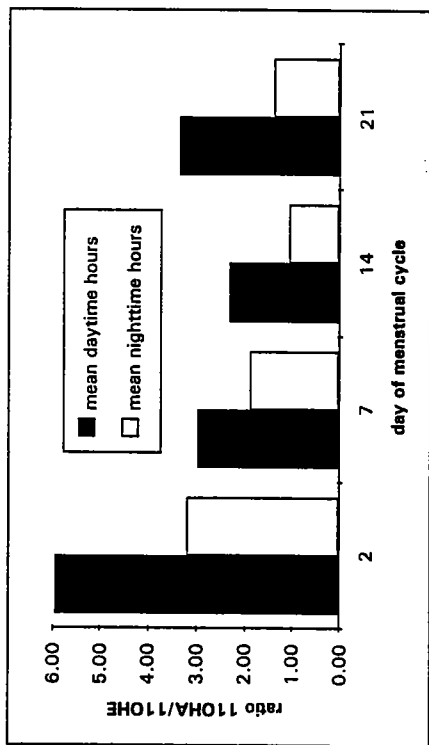


fig 3: ratio (concentration) 11OHA/11OHE in female urine, collected over 24 hours at four different times (different days of the female menstrual cycle)

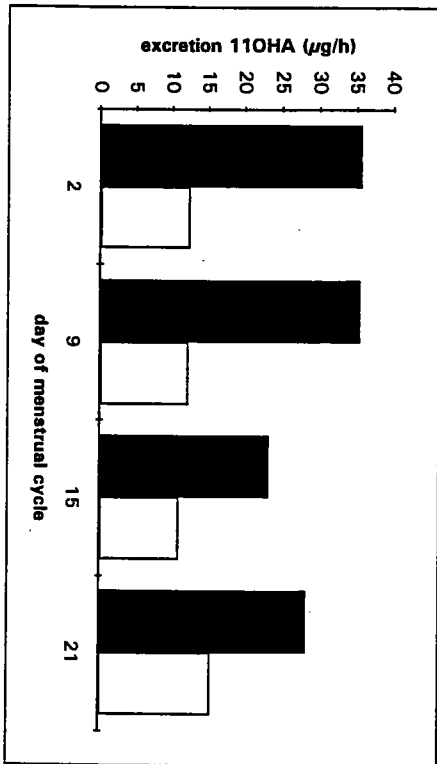
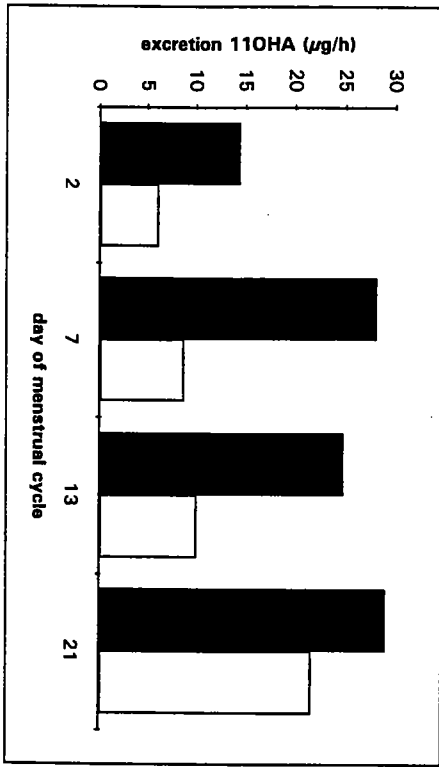
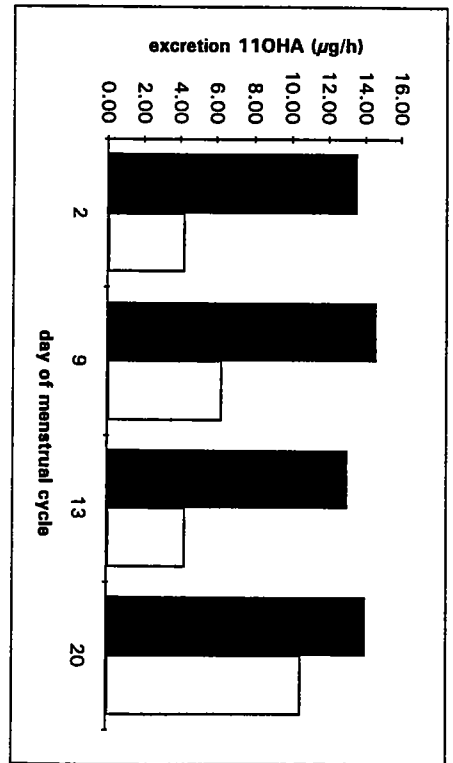
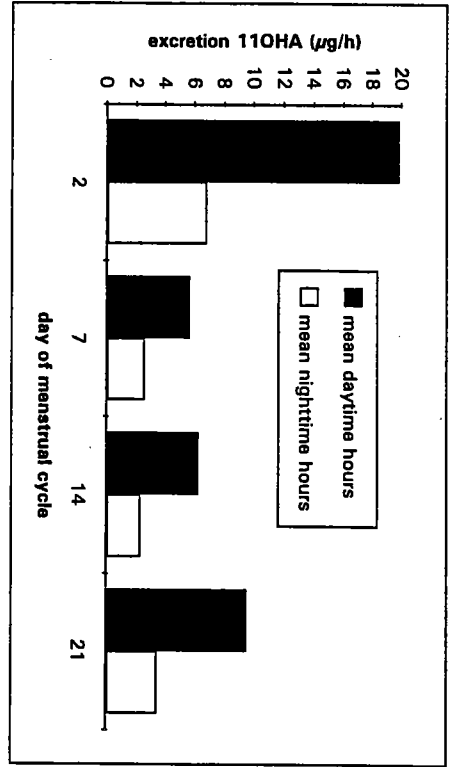
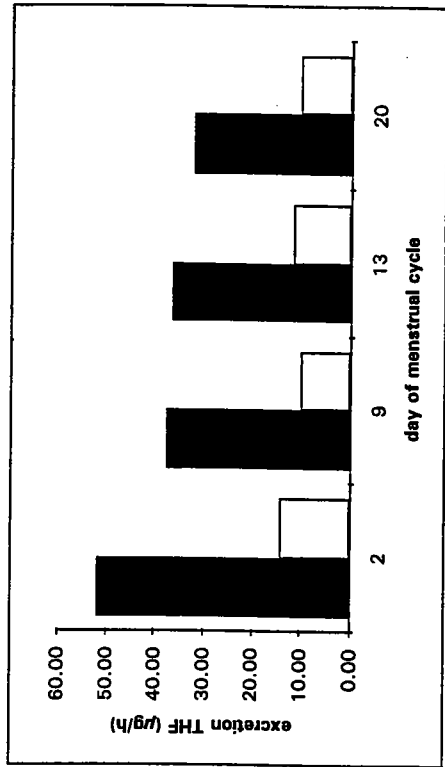
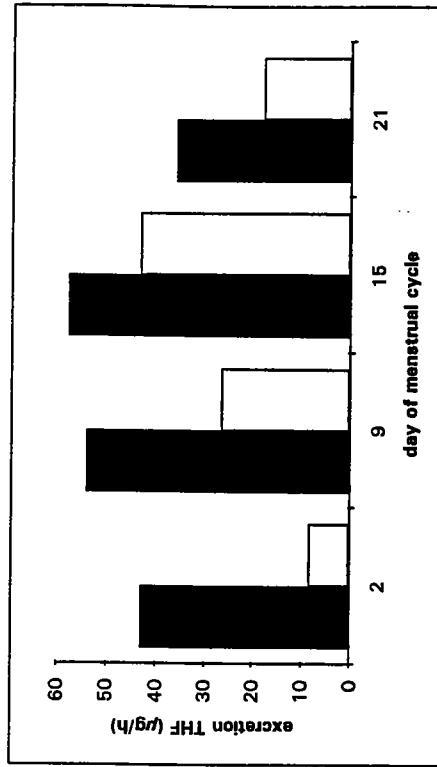


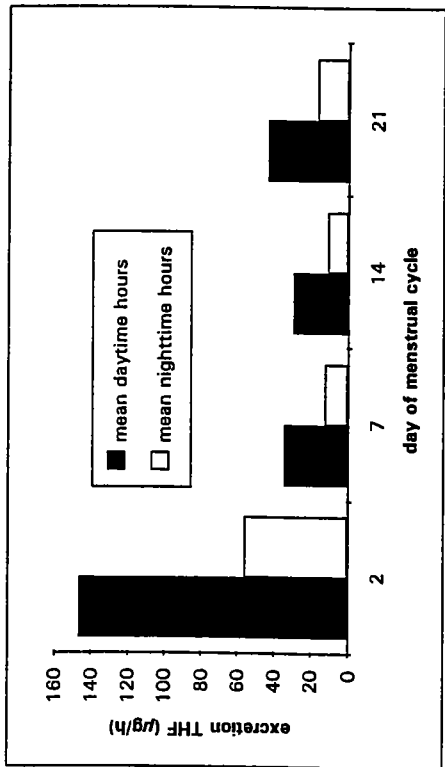
fig 4: excretion 11OHA (µg/h) in female urine, collected over 24 hours at four different times (different days of the female menstrual cycle)



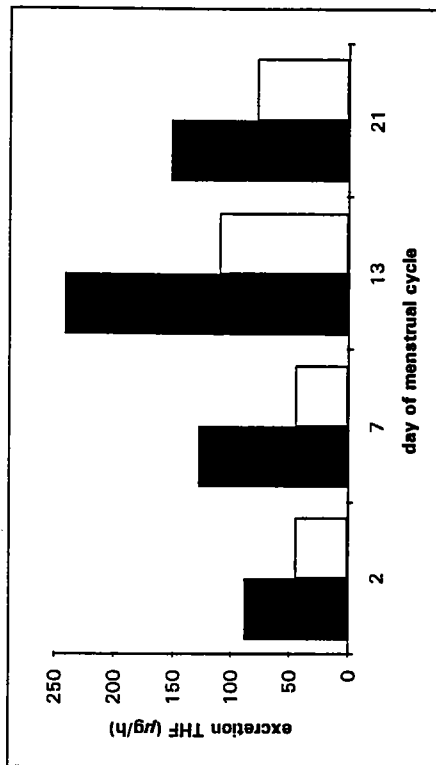
volunteer 3



volunteer 4



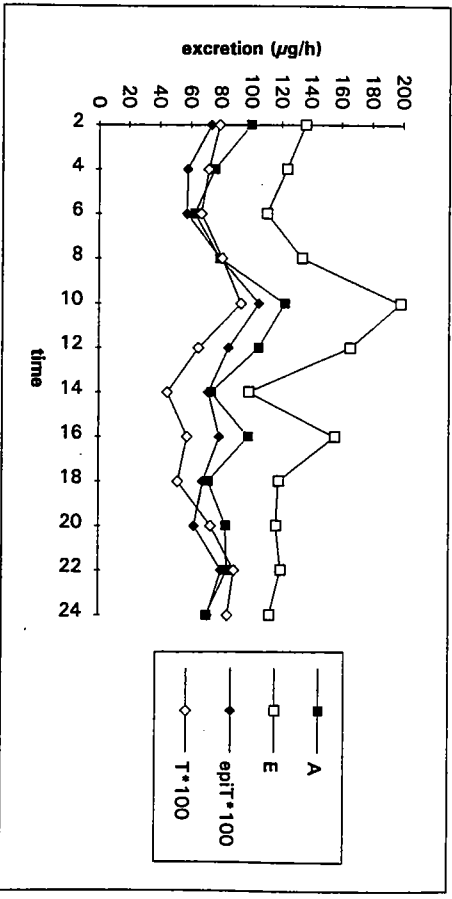
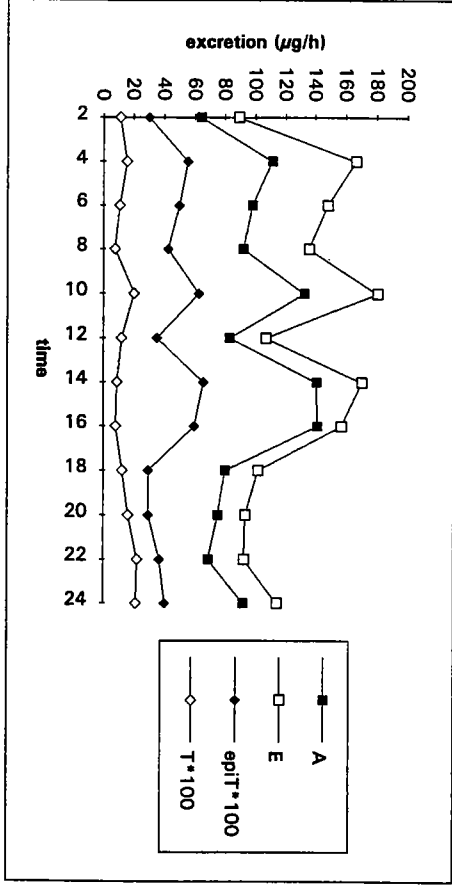
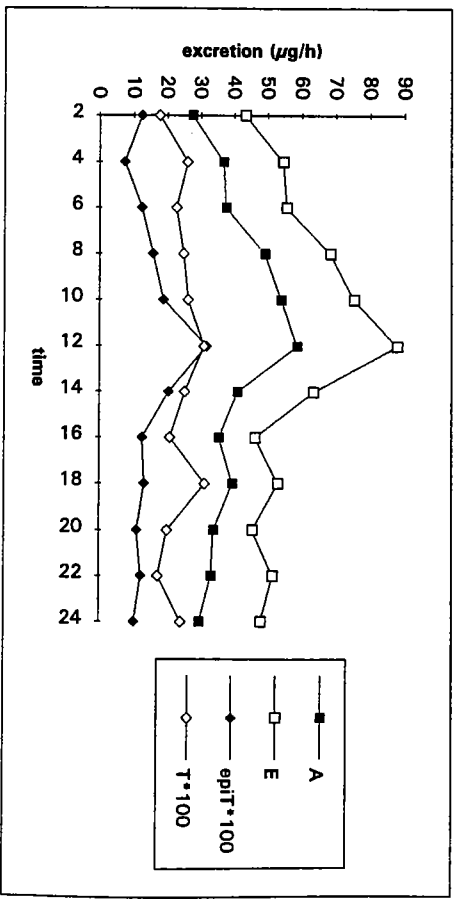
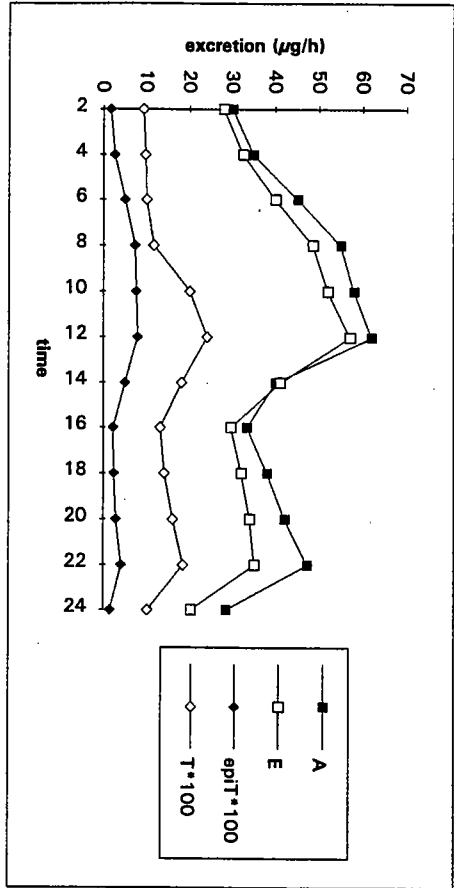
volunteer 1

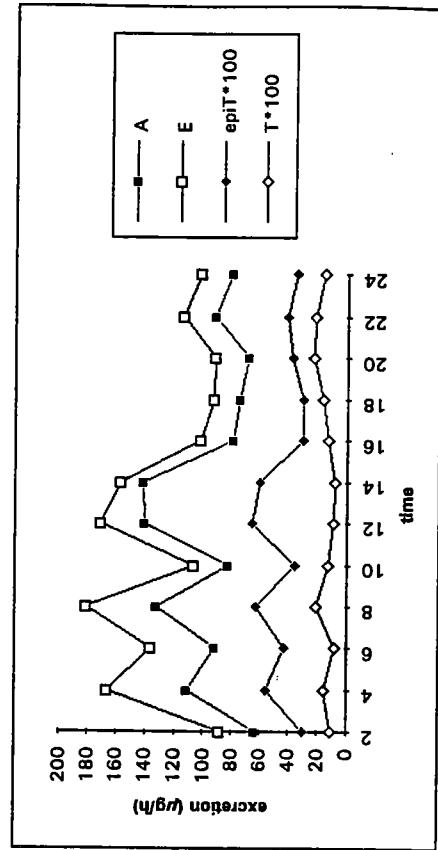


volunteer 2

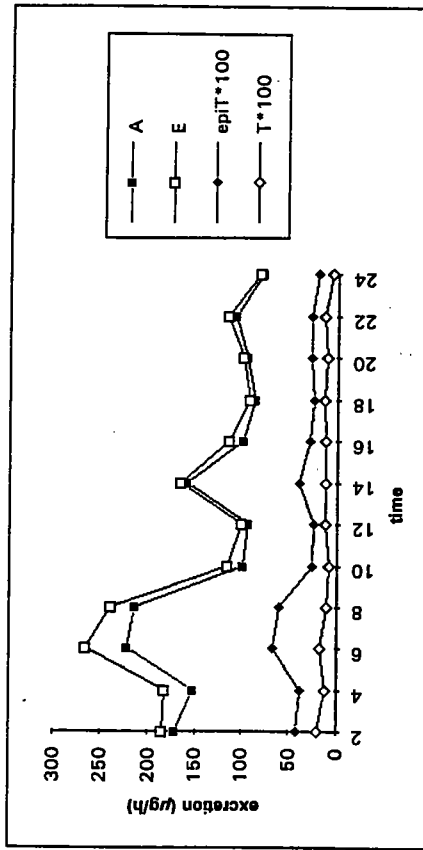
fig 5: excretion THF ($\mu\text{g/h}$) in female urine, collected over 24 hours at four different times (different days of the female menstrual cycle)

fig 6: excretion rates of endogenous steroids in female urine, collected at the 14th day of the female menstrual cycle

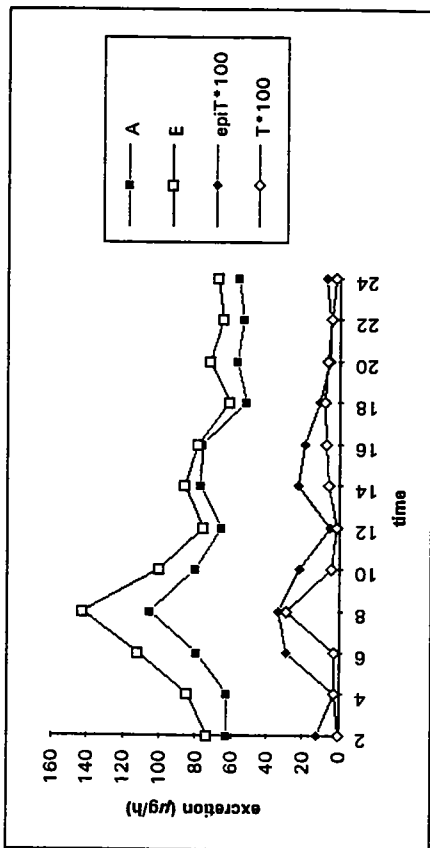




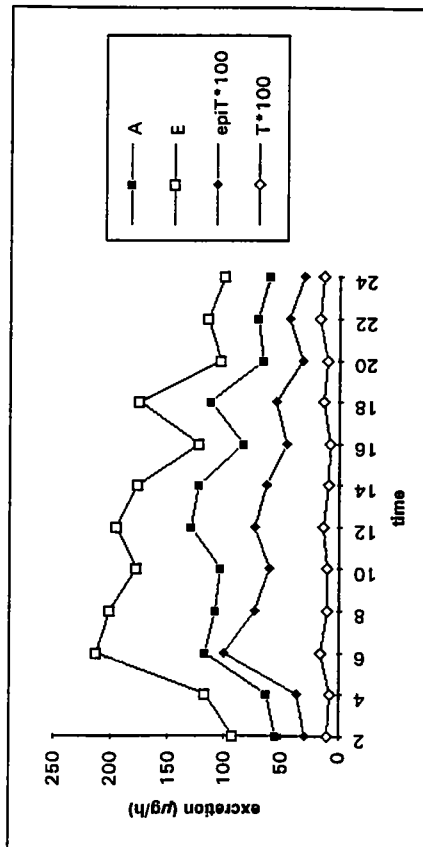
13th day of menstrual cycle



21th day of menstrual cycle



2nd day of menstrual cycle



7th day of menstrual cycle

fig 7: excretion rates of endogenous steroids in female urine (volunteer 2), collected over 24 hours at four different times (different days of the female menstrual cycle)

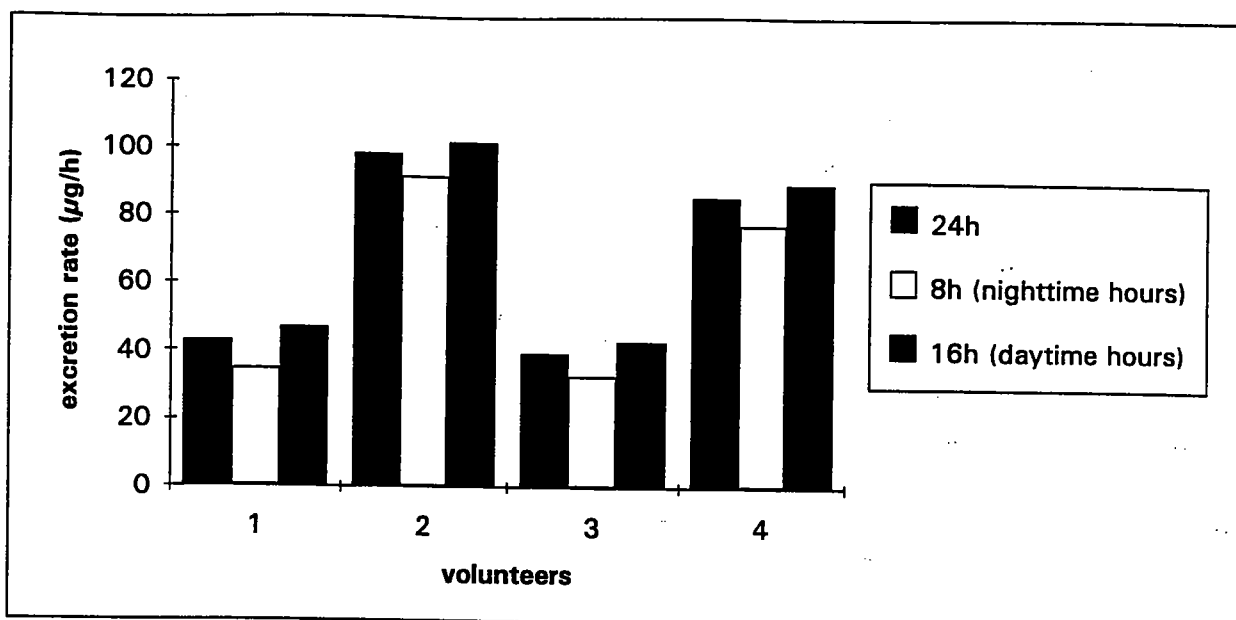


fig 8: Androsterone excretion ($\mu\text{g/h}$)
comparison of daytime hours and nighttime hours with 24 hours collected urine
(female urine, collected at the 14th day of the female menstrual cycle)

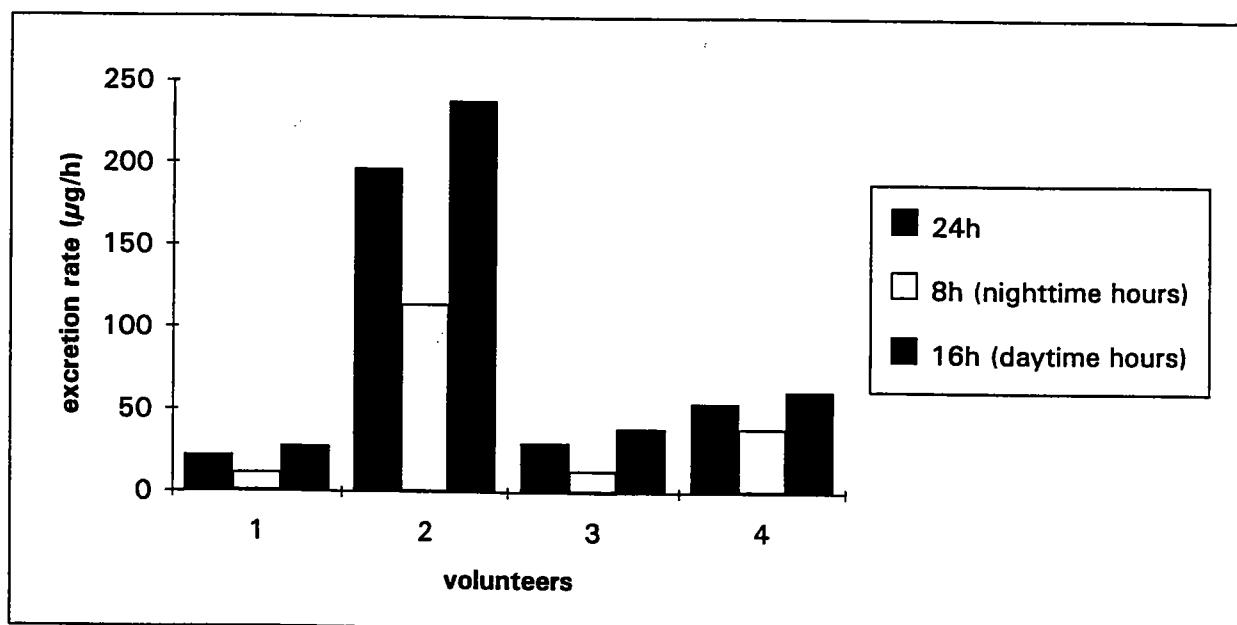
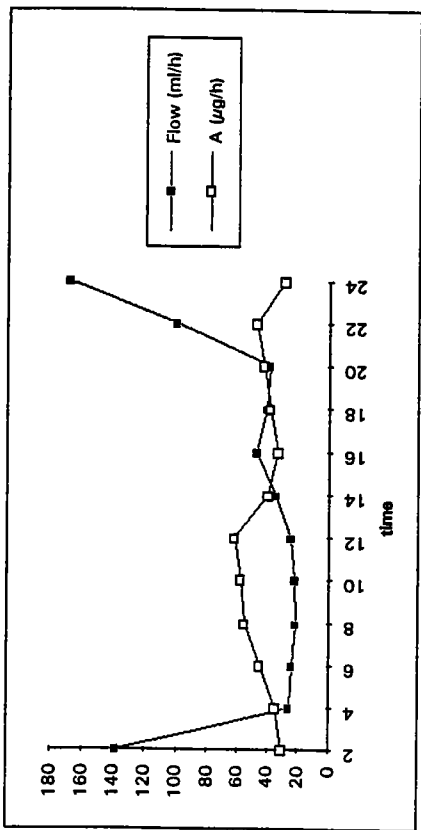
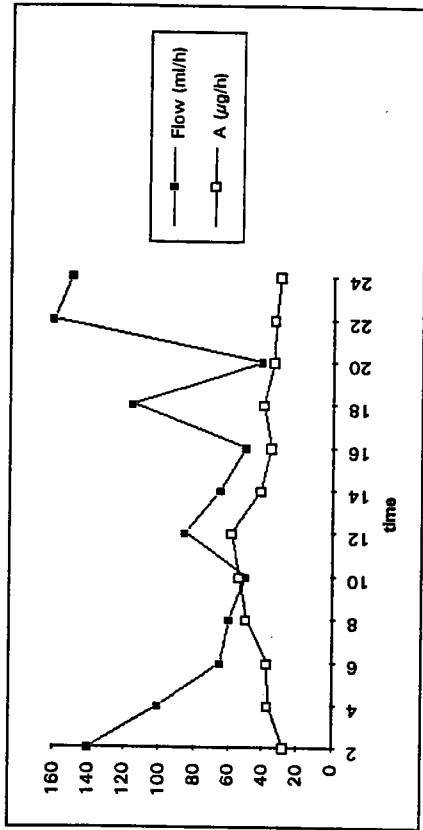


fig 9: THF excretion ($\mu\text{g/h}$)
comparison of daytime hours and nighttime hours with 24 hours collected urine
(female urine, collected at the 14th day of the female menstrual cycle)

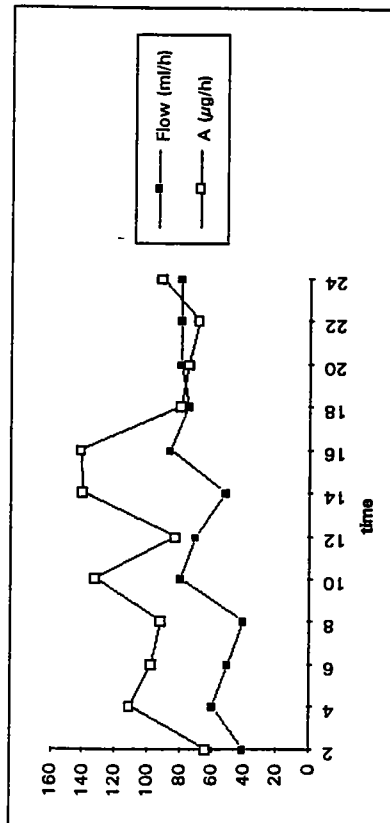
The real calculated excretion amount for 24 hours is compared with values calculated for 24 hours from sleeping hours and wake hours. Excretion rates obtained during the nighttime hours and daytime hours are added cumulatively and the values normalized to 24 hours.



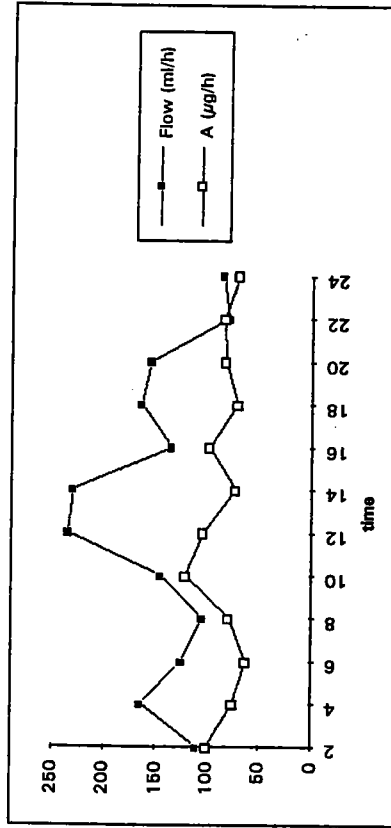
Volunteer 1



Volunteer 3



Volunteer 2



Volunteer 4

fig 10: correlation between excretion of A ($\mu\text{g/h}$) and flow (ml/h) - female urine, collected at the 14th day of the female menstrual cycle