University Grants Commission

Characterization of Human Sweat molecules among Indians

UGC Reference NoF. 43-584/2014 (SR)

Principle Investigator
Dr. Richa Ashma
Department of Zoology
Savitribai Phule Pune University
Pune - 411007

Annexure - III

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

STATEMENT OF EXPENDITURE IN RESPECT OF MAJOR RESEARCH PROJECT

1. Name of Principal Investigator: **Dr. Richa Ashma**

2. Deptt. of University/College: **Department of Zoology, Savitribai Phule Pune University**

3. UGC approval No. and Date: **43-584/2014 (SR) dated: 30/10/2015**

4. Title of the Research Project : **"Characterization of Human Sweat molecules among Indians"**

5. Effective date of starting the project **01/07/2015**

6. a. Period of Expenditure: From **01/07/2015** to **30/06/2018**

   b. Details of Expenditure: **Rs. 14,33, 412/-**

S.No.	Item	Amount Approved Rs.	Expenditure Incurred Rs.
i.	Books & Journals	0/-	0/-
ii.	Equipment ***(quotation enclosed)***	5,00,000/-	5,00,000/-
iii.	Contingency	1,00,000/-	94,082/-
iv.	Field Work/Travel ***(Annexure- IV)***	75,000/-	21,303/-
v.	Hiring Services	50,000/-	39,278/-
vi.	Chemicals & Glassware	1,50,000/-	1,48,488/-
vii.	Overhead	82,800/-	82,751/-
viii.	Any other items (Please specify)	0/-	0/-

c . Staff

Date of Appointment: **22nd January, 2016**

S.No.	Expenditure Incurred	From to	Amount Approved (Rs.)	Expenditure Incurred(Rs.)
1.	Project Associate salary @ Rs.14,000/- p.m (for 1st and 2nd year) and @ Rs. 16000/- p.m(for 3rd year)	13/02/2016 30/06/2018	**4,21,160/-**	**4,21,161/-**
2.	Project Associate HRA (for 1st, 2nd and 3rd Year)	13/02/2016 30/06/2018	**1,26,348/-**	**1,26,349/-**
	Total		**5,47,508/-**	**5,47,510/-**

1. It is certified that the appointment(s) have been made in accordance with the terms and conditions laid down by the Commission.

2. It as a result of check or audit objective, some irregularly is noticed, later date, action will be taken to refund, adjust or regularize the objected amounts.

3. Payment @ revised rates shall be made with arrears on the availability of additional funds.

4. It is certified that the grant of Rs. **13,47,057/- (RupeesThirteen Lakhs, forty-seven thousand and fifty seven only)** received from the University Grants Commission under the scheme of support for Major Research Project entitled "**Characterization of Human Sweat molecules among Indians"** vide UGC letter No. F. **43-584/2014 (SR) dated: 30/10/2015.** Amount of Rs. **14,33,412** has been utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

PRINCIPAL INVESTIGATOR **Head of the Department**

FINANCE OFFICER
REGISTRAR/PRINCIPAL

(Signature with Seal) **(Signature with Seal)**

Annexure - IV

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

STATEMENT OF EXPENDITURE INCURRED ON FIELD WORK

Name of the Principal Investigator: Dr. Richa Ashma

Name of the Place visited	Duration of the Visit		Mode of Journey	Expenditure Incurred (Rs.)
	From	To		
IIT Powai, Mumbai, Maharashtra	31/03/2016	31/03/2016	University Vehicle	2,129/-
Kothrud, Yerwada, Pune, Maharashtra	29/07/2016	29/07/2016	University Vehicle	1,632/-
UraliKanchan,Maharashtra	10/01/2017	10/01/2017	University Vehicle	2,735/-
Dighi and Katraj, Pune UGC, Delhi	31/03/2017 18/04/2017	31/03/2017 19/04/2017	University Vehicle Flight	4,832/- 8,298/-
Camp, Pune	28/08/2017	28/08/2017	University Vehicle	1,378/-
Pune airport	20/04/2017	20/04/2017	University Vehicle	299/-

Certified that the above expenditure is in accordance with the UGC norms for Major Research Projects.

PRINCIPAL INVESTIGATOR **Head of the Department**

Finance Officer **REGISTRAR/PRINCIPAL**

(Seal) **(Seal)**

Annexure - V

UNIVERSITY GRANTS COMMISSION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002

Utilization certificate

Certified that out of the sanctioned grant of **Rs. 15,05,308/- (Rupees Fifteen Lakhs, Five thousand three hundred eight)** and received **Rs 13,47,057/- (Rupees Thirteen Lakhs, forty-seven thousand and fifty seven only)** from the University Grants Commission under the scheme of support for Major Research Project entitled "**Characterization of Human Sweat molecules among Indians**"

vide UGC letter No. F.**43-584/2014 (SR)** dated **30/10/2015.** Amount of Rs. **14,33,412/- (Rupees Fourteen Lakhs, Thirty-three thousand, four hundred twelve)** has been utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

PRINCIPAL INVESTIGATOR **Head of the Department**

Finance Officer **Registrar/Principal**
(Seal) **(Seal)**

Annexure-VI

PROFORMA FOR SUPPLYING THE INFORMATION IN RESPECT OF THE STAFF APPOINTED UNDER THE SCHEME OF MAJOR RESEARCH PROJECT

UGC File No. F. **43-584/2014 (SR)** (HRP) Year of Commencement 01/07/2015

Title of the Project: **Characterization of Human Sweat molecules among Indians**

<table>
<tr><td>1</td><td>Name of the Principle Investigator</td><td colspan="5">Dr. Richa Ashma</td></tr>
<tr><td>2</td><td>Name of the University/College</td><td colspan="5">Savitribai Phule Pune University</td></tr>
<tr><td>3</td><td>Name of the Research Personnel appointed</td><td colspan="5">Ms. Soni H. Ghumnani</td></tr>
<tr><td>4</td><td>Academic Qualification</td><td colspan="5"><table><tr><th>S. No</th><th>Qualification</th><th>Year</th><th>Marks</th><th>%age</th></tr><tr><td>1</td><td>M.Sc</td><td>2014</td><td>1775/2500</td><td>71</td></tr><tr><td>2</td><td>Gate Qualified</td><td>2015</td><td>Score: 374</td><td>Rank: 1128</td></tr></table></td></tr>
<tr><td>5</td><td>Date of Joining</td><td colspan="5">22nd January, 2016</td></tr>
<tr><td>6</td><td>Date of birth of research personnel</td><td colspan="5">1st October, 1991</td></tr>
<tr><td>7</td><td>Amount of HRA, if drawn</td><td colspan="5">126,349</td></tr>
<tr><td>8</td><td>Number of candidate applied for the post</td><td colspan="5">Seven</td></tr>
</table>

Certificate

This is to certify that all the rules and regulations of UGC Major Research Project outlined in the guidelines have been followed. Any lapse on the part of the University will liable to terminate the said UGC project

Principal Investigator **Head of the Department**

Finance Officer **Registrar/Principal**

Annexure – VII

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

MAJOR RESEARCH PROJECT COPY OF THE SPECIMEN OF HOUSE RENT FOR PROJECT FELLOW

Certified that Ms Soni Ghumnani has withdrawn House Rent allowance of Rs. 126,349/- @ 30% for the fellowship amount Rs. 421161/- from date 22/01/2016 to 30/06/2018.

Finance Officer
(Signature with Seal)

Registrar/Principal
(Signature with Seal)

Annexure -VIII

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002.

Annual/Final Report of the work done on the Major Research Project.

1. Project report No. 1st /2nd /3rd/Final: **Final**
2. UGC Reference No.F. **43-584/2014 (SR)**
3. Period of report: **from 1st July, 2015 to 30th June, 2018**
4. Title of research project: "**Characterization of Human Sweat molecules among Indians"**
5. (a) Name of the Principal Investigator: **Richa Ashma**
   (b) Deptt. **Department of Zoology**
   (c) University/College where work has progressed: **Savitribai Phule Pune University**.
6. Effective date of starting of the project: **1st July, 2015**
7. Grant approved and expenditure incurred during the period of the report:
   a. Total amount approved **Rs.** 15, 05,308/-
   b. Total expenditure **Rs.** 14,33,412/-

c. Report of the work done: (Please attach a separate sheet)

i. Brief objective of the project

1. **To identify specific odor components belonging to different individuals which leads to individuality.**
2. **To identify different components of odor pertaining to different age groups, genders, diet and ethnicity.**
3. **To identify individuals belonging to different age groups, genders, diet and ethnicity based on their odor profile**.

ii. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication

Annexure IX

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIME OF SENDING THE FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. Title of the Project: "**Characterization of Human Sweat molecules among Indians"**

2. NAME AND ADDRESS OF THE PRINCIPAL INVESTIGATOR: **Richa Ashma**
Address: **Department of Zoology, Savitribai Phule Pune University**.

3. NAME AND ADDRESS OF THE INSTITUTION : Department of Zoology, **Savitribai Phule Pune University**, Ganeshkhind road, pune-411007.

4. UGC APPROVAL LETTER NO. AND DATE: **43-584/2014 (SR) dated: 30/10/2015**

5. DATE OF IMPLEMENTATION : 1/07/2015

6. TENURE OF THE PROJECT : 3 years

7. TOTAL GRANT ALLOCATED : 15, 05,308/-

8. TOTAL GRANT RECEIVED: 13,47,057

9. FINAL EXPENDITURE : 14,33,412/-

10. TITLE OF THE PROJECT: "**Characterization of Human Sweat molecules among Indians"**

11. OBJECTIVES OF THE PROJECT

1. To identify specific odor components belonging to different individuals which leads to individuality.

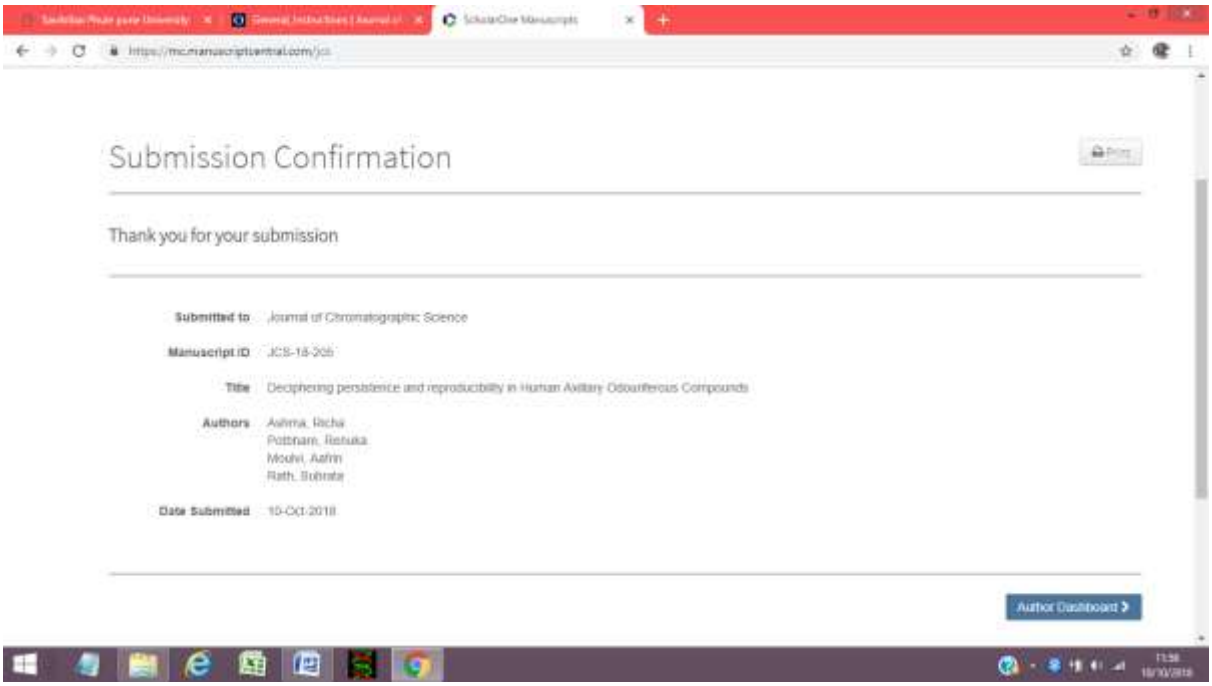
2. To identify different components of odor pertaining to different age groups, genders, diet and ethnicity.

3. To identify individuals belonging to different age groups, genders, diet and ethnicity based on their odor profile.

12. WHETHER OBJECTIVES WERE ACHIEVED: Yes (GIVE DETAILS).

The objectives were successfully achieved and One paper published in **in "The American Journal of Forensic Medicine and Pathology. 39(2):141–147**

The other paper is communicated in the **"Journal of Chromatographic Science"** entitled as"Deciphering persistence and reproducibility in human axillary odouriferous compounds"



13. ACHIEVEMENTS FROM THE PROJECT

One paper

14. SUMMARY OF THE FINDINGS. (IN 500 WORDS)

There is a strong evidence in the literature that human odor is unique to an individual; therefore, the focus of this study was to strengthen this evidence through the testing of sweat samples on unrelated individuals with the same ethnicity. Sweat samples were collected from 42 unrelated Indian males and females residing in the same city to determine the chemical constituents in human sweat. The volatile compounds of sweat were subsequently analyzed and identified using gas chromatography–mass spectrometry and a National Institute of Standards and Technology library was used for individual profiling. A total of 78 compounds were identified in human sweat tested with 22 compounds found to be unique to the individual (frequency of occurrence one). A scent profile, or "chexmotype," unique to the sweat of each individual was obtained. This is the first extensive study on an Indian population with 36 new compounds detected in human sweat.

15. CONTRIBUTION TO THE SOCIETY (GIVE DETAILS)

This study will help in the identification of individual

16. WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE PROJECT

One MPhil student enrolled out from this project.

17. NO. OF PUBLICATIONS OUT OF THE PROJECT (PLEASE ATTACH)

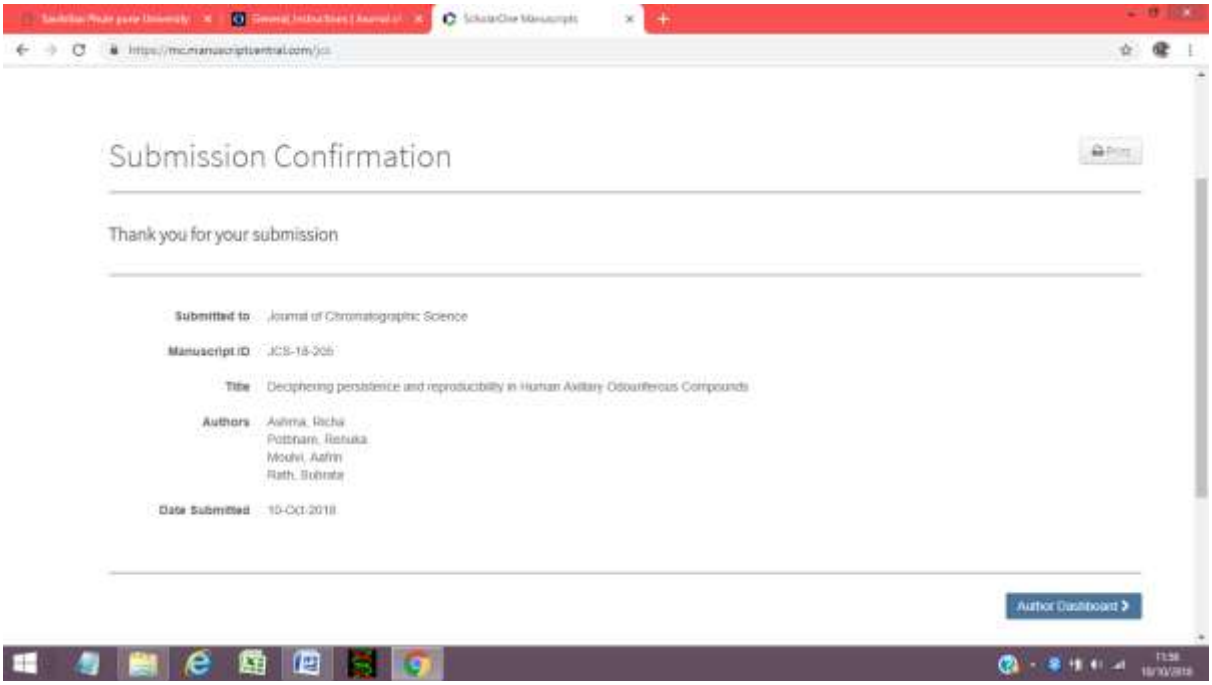
One paper published in **in "The American Journal of Forensic Medicine and Pathology. 39(2):141–147**

ORIGINAL ARTICLE

Characterization of Chemical Constituents of Human Sweat

A Study Based on Indian Population

The other paper is communicated in the "Journal of Chromatographic Science" entitled as"Deciphering persistence and reproducibility in human axillary odouriferous compounds"



(PRINCIPAL INVESTIGATOR) **(REGISTRAR/PRINCIPAL)**

(Seal)

Annexure-X

ASSESMENT CERTIFICATE

(to be submitted with the proposal)

It is certified that the proposal entitled "**Characterization of Human Sweat molecules among Indians"** by Dr. Richa Ashma, Department of Zoology has been assessed by the following members for submission to the University Grant Commission, New Delhi for financial support under the scheme of Major Research Projects:

Details of Expert Committee:

The proposal is as per the guidelines.

(REGISTRAR/ PRINCIPAL)

(Seal)

Sample Collection:

The objective of this study is to identify odor molecules and to find reason for uniqueness in human odor. To carry out this work human sweat samples have been collected from healthy individuals in the three seasons i.e. summer, monsoon and winter during the period April 2016- December 2016.

Human Ethics approval was taken from ethics committee, Savitribai Phule Pune University for this study. All participants were genetically unrelated, belonged to one community with similar dietary pattern residing in the same geographical area (Nasik city in Maharashtra, India).Written informed consent and a brief history of individual's lifestyle habits has also been taken. There are a total of 36 males and 19 females in the ages between 12 and 50 years. They were healthy with no history of any kind of dermatological disease, non-alcoholics and non-smokers and not taking long term medication (Diabetes, CVD, hypertension etc.) or antibiotics. Subjects were asked to avoid underarm shaving, bathing, cosmetic items like deodorants or perfumes and food items like onion, garlic, cabbage and chillies 24 hours prior to sample collection. Subjects were provided with a detailed questionnaire which included information about their age, sex, alcohol or tobacco use, diet, medication and menstrual cycle. The dietary habits of individuals were noted in detail and subject with similar habits were recruited for the study. Participants were also asked to maintain their dietary pattern same as much as possible throughout the study period.

Odour collection and extraction

The odour samples were collected from individuals on sterilised and analytically clean cotton pads (Curran *et al* 2005). The subjects were asked to keep these cotton pads in their armpit for a maximum period of twelve hours during which they were asked to carry out their routine activities. The odour compounds were extracted from samples by the method described by Hasegawa *et al* (2004) using diethyl ether and sent for GC-MS analysis to IIT Mumbai.

Gas Chromatography- Mass Spectrophotometry

The samples were subjected to GC-MS Agilent 6890 at SAIF, IIT POWAI. The capillary column was a DB-5MS (20 m,0.18 mm, i.d., and 0.18mm in film thickness) from Agilent Technologies

(Wilmington, DE). The temperature cycle used is as stated by Hasegawa *et al* (2004). The peaks obtained were compared and identified from the compounds present in NIST library.

Results

A variety of compounds were obtained after the analysis of samples from summer - 2016 season. Several Classes of compounds belonging to Carboxylic Acids, Thiols, Alcohols, Aldehydes, Ketones, Esters, Hydrocarbons and Nitrogen containing compounds were identified from NIST Library. The compounds had been categorized as: primary odor which comprises of endogenous compounds, secondary odor which also comprises of endogenous compounds but are influenced by diet, tertiary compounds comprise of exogenous compounds found due to the use of skin creams, lotions, perfumes, etc (Table: 1).

Table-1: Categorization of sweat compounds obtained after GC-MS analysis.

Primary Odor	**Secondary / dietary Odor**	**Tertiary Odor**	**Unknown origin**
Carboxylic Acids	**Carboxylic Acids**	**Esters**	**Alcohols**
n-hexadecanoic acid	Hexadecanoic acid methyl ester	1,2-benzenedicarboxylicacid mono [2-ethyl hexyl ester] (reported in sweat)	3-methyl oxiran 2yl methanol
Pentanoic acid	Alcohols	Decanedioic acid dibutyl ester	1,2 Benzenediol o,o diethoxy carbonyl
Dodecanoic acid	β sitosterol (reported in feaces, not synthesized in the human body)	1,2 Benzenedicarboxylic acid diso octyl ester	1,2 Benzenediol o,o -ethoxy carbonyl
Z-8-methyl-9-tertadecanoic acid	1-hexanol-2-ethyl (found in urine)	Benzoic acid 4-ethoxy ethyl ester	y-sitosterol
3,5 di-tert-butyl benzoic acid	Ketones	Alcohols	3-methyl-oxiran-2yl-methanol
Propanoic acid 2,2-dimethyl	Hydroquinone (coffee, cereals and plants)	1-pentanol-2-ethyl-4-methyl	Ethanol 2 nitro
Alcohols	**Hydrocarbons**	Phenol 4,4-methylene bis	**Hydrocarbons**
3,5,di-tert-butyl-4-hydroxy	Styrene	**Hydrocarbons**	Naphthalene
4,4-Ethylene bis [2,6-di-tert-butyl phenol	BHT	Ethyl Benzene	Cycloheptasiloxane tetradecamethyl
Phenol	**Hydrocarbons**	Styrene	4[4-methyl [1,3,2] dioxaborinan
1-pentanol-2-ethyl-4-methyl	2-Cyclopenten-1-one2,3,4-trimethyl	cyclohexasiloxanedodecamethyl	1,3,5trioxepane
Phenol 3 pentadecyl	2,5-cyclohexadene-1,4 dione 2,5bis,1,1-dimethyl propyl	p-benzoquinone	Tetrapentacontane 1,5,4-dibromo
Phenol 2-[1-phenylethyl]	2,5-cyclohexadene-1,4 dione 2,6 bis,[1,1-dimethyl ethyl]	BHT	p-xylene
4,6-di-tert-butyl-m-cresol	3,5-cyclohexadiene-1,2dione 3,5bis[,1,1-dimethyl ethyl]	Hydroquinone (skin lightening creams)	Hydroquinone acetate
9-Octadecanal-2-vloxyl phenol	Heptacosane		Toluene
Trimethylsilylmethanol	Heneicosane		Benzene1,3dimethyl aka m-xylene
Phenol2,6-bis[1,1-dimethylethyl]-4-ethyl	Nonane		Cycloheptasiloxane tetradecamethyl
4,4-ethylene bis 2,6-di-tert-butyl phenol	Benzene[1 methylbutyl]		Bicyclo [4.2.0]octa1,3,5-triene

1-pentanol-2-ethyl-4-methyl	1-Docosene		Squalene
Phenol 2,4-bis[1-phenylethyl]	Octadecane 3 ethyl-5-(2-ethylbutyl)		Aldehyde
	Esters		paraldehyde
Ketones	Ethylacetate		3,5-di-tert-butyl-4-hydroxybenzaldehyde
2-heptanone 3-methyl	acetic acid butyl ester		**Ketones**
2,4,6 cycloheptatrien-1-one	Hydrazinecarboxylic acid, phenylmethyl ester		1,4 Naphthoquinone2,3-dihydro5,8 dimethyl
1S,4R,7R,11R-1,3,4,7-Tetramethyl tricyclo [5.3.1.0[4,11]]undec-2-en-8-one	Sulfurous acid hexyl pentadecyl ester		4,5-dimethyl-2-pyrimidone;
2-Cyclopenten-1-one 2,3,4-trimethyl	Pentanoic acid 5 hydroxy 2,4di-t-butylphenylester		3-H Cycloprop[1,2]5αcholest-1-en-3one 1',1'dicarboethoxy 1β 2 βdihydro
3,5 di tert butyl-4-hydroxyacetate phenone	2-propenoic acid oxybis [methyl 2,1-ethanedyl] ester		2,6-Bis[1,1-dimethylethyl]-4,4-dimethylcyclohexa-2,5-dien-1-one
2-Hexanone-dimethyl 3,4	Thiols		Amines
4-heptanone 3 methyl n breath	Undecanethiol 2-methyl		n-hexylmethylamine
Hydrocarbons	terthexadecanethiol		9-Octadecenamide(Z)
1-nonadecene			1-methyl dodecylamine
Hexadecane			Benzenethaneamine3,4-benzyloxy-2,5-difluoro β-hydroxy-N-methyl
Cyclohexane 1,3-dimethyl cis			Ester
Octane			E-10,13,13-Trimethyl 1,1-tetradecen-1-ol-acetate
Octadecane,3-ethyl-5[2-ethylbutyl]			
Tridecane 2-methyl			
Eicosane 2 methyl			
tetrapentacontane1,5,4 dibromo			

There were some compounds which were observed commonly among different individuals, irrespective of their age and gender. We called these compounds as “frequently present compounds” and checked for their source (table -2). Among these frequently present compounds, there were three compounds viz. Octadecane 3-ethyl-5-[2-ethylbutyl], E-10,13,13-trimethyl-11-tetradecen-1-ol acetate, Tetrapentacontane 1,5,4-dibromo that are present in majority of individuals in the study group. Thus compounds with highest frequency of occurrence may have significance in identifying individuals when we compare individuals of different geographical area, community and diet

Table 2: List of prevalent compounds along with percentage of individuals in which they are present and source of compounds.

Most frequent compound	Frequency	Percentage of individuals	Source of compound
E-10,13,13-trimethyl-11-tetradecen-1-ol acetate	27	64.28	Unknown origin
Tetrapentacontane 1,5,4-dibromo	23	54.76	Primary
Octadecane 3 ethyl-5-(2-ethylbutyl)	21	50	Primary
Squalene	6	14.28	Unknown origin
4,4-ethylene bis 2,6-di-tert-butyl phenol	6	14.28	Primary
3,5 di tert butyl-4-hydroxyacetate phenone	6	14.28	Primary
β sitosterol	5	11.9	Secondary
y-sitosterol	5	11.9	Unknown origin
Z-8-methyl-9-tertadecanoic acid	5	11.9	Primary
Decanedioic acid dibutyl ester	5	11.9	Tertiary
Terthexadecanethiol	5	11.9	Primary

On the other hand, the compounds with low frequency of occurrence can provide clues of uniqueness in odour profile (table -3). The complete set of compounds in an individual was referred to as ‘chemotype’ (just as haplotype based on unique allele set in case of STR alleles).

Table-3: Chemotype of individuals

Individuals	Sex	Age	No. of compounds/individual	Known compounds	Chemotype
1	F	32	1	137	1
2	F	50	2	142;178	1
3	F	21	2	176;179	1
4	F	17	4	76;162;178;179;	1
5	F	40	4	13;97;178;179	1
6	F	35	4	57;161;162;178	1
7	F	50	4	6;142; 150;179;	1
8	F	32	5	3;9;23;178;179	1
9	F	12	5	45;98;115;122;157	1
10	F	47	5	36;86;97; 176;178	1
11	F	26	5	88;161;176;178;179	1
12	F	38	5	98;115;136;178;179	1
13	F	34	7	82;83;122;129;158;161;178	1
14	F	16	8	37;38;137;152;154;176;178;179	1
15	F	25	10	26;29;44;57;71;87;118;126;158;176	1
16	M	20	1	42	1
17	M	33	1	179	1
18	M	35	2	150;179	1
19	M	19	3	154;157;179	1
20	M	30	3	131;144;178	1
21	M	15	3	142;159;179	1
22	M	21	4	1;85;136;179	1
23	M	20	5	49;66;83;86;159;	1
24	M	17	5	52;55;126;137;162;	1
25	M	26	5	118;119;162;176;178	1
26	M	43	6	52;55;126;137;162;167	1
27	M	36	6	22;54;82;133;150;157;	1
28	M	55	6	31;67;94;118;152;158	1
29	M	23	6	7;10;119;150;159;179	1
30	M	14	6	28;159;161;176;178;179	1
31	M	14	6	77;94;144;154;162;178	1
32	M	22	7	14;75;128;129;142;157;178	1
33	M	23	7	68;81;95;121;176;178;179	1
34	M	24	7	109;121;138;158;176;178;179	1
35	M	22	7	131;136;152;159;162;176;178	1
36	M	25	8	2;21;62;73;85;87;109;138	1
37	M	20	8	30;95;116;119;121;144;158;176	1
38	M	44	8	12;15;116;128;133;176;178;179	1
39	M	29	8	74;122;126;129;150;154;176;179	1
40	M	21	8	88;137;138;144;161;176;178;179	1
41	M	48	8	131;138;152;154;159;161;176;178	1
42	M	24	12	5;8;11;27;39;46;79;128;133;176;178;179	1

Later, chemotype frequencies were calculated (table -4).

Table 4: List of unique compounds along with their source

Compound	Frequency	Source
9-Octadecanal-2-vloxyl phenol	1	Primary
Benzenethaneamine3,4-benzyloxy-2,5-difluoro β-hydroxy-N-methyl	1	Unknown origin
Hydrazinecarboxylic acid, phenylmethyl ester	1	Primary
Cyclohexane 1,3-dimethyl cis	1	Primary
Toluene	1	Tertiary
Pentanoic acid	1	Primary
n-hexylmethylamine	1	Unknown origin
Octane	1	Primary
Trimethylsilylmethanol	1	Primary
Propanoic acid 2,2-dimethyl	1	Tertiary
Ethyl acetate	1	Secondary
1,3,5trioxepane	1	Unknown origin
3-methyl-oxiran-2yl-methanol	1	Unknown origin
2-isopropoxyethylamine	1	Unknown origin
Ethanol 2 nitro	1	Unknown origin
Propylene glycol	1	Tertiary
Acetic acid butyl ester	1	Primary
p-xylene	1	Unknown origin
Ethyl Benzene	1	Tertiary
4,5-dimethyl-2-pyrimidone	1	Unknown origin
Styrene	1	Secondary
Bicyclo(4,25)octa 1,3,5,triene	1	Unknown origin
Nonane	1	Secondary
Acetic acid (acetyloxy)	1	Unknown origin
p-benzoquinone	1	Tertiary
2-Hexanone-dimethyl 3,4	1	Primary
4-heptanone 3-methyl	1	Primary
Phenol	1	Primary
Undecanethiol 2-methyl	1	Secondary
1-hexanol-2-ethyl	1	Secondary
2-acetonyl-9-[β-ribofuranosyl]purine	1	Unknown origin
2-cyclopenten-1-one 2,3,4- trimethyl	1	Primary
2,4,6-cycloheptatrien-1-one	1	Secondary
Naphthalene	1	Unknown origin
Benzene[1 methylbutyl]	1	Primary
Hydroquinone	1	Tertiary
2,6-Bis[1,1-dimethylethyl]-4,4-dimethylcyclohexa-2,5-dien-1-one	1	Unknown origin
cyclohexasiloxanedodecamethyl	1	Tertiary
2,5-cyclohexadene-1,4 dione 2,5bis,1,1- dimethyl propyl	1	Primary
Hydroquinone acetate	1	Unknown origin
2,5-cyclohexadene-1,4 dione 2,6 bis,[1,1- dimethyl ethyl]	1	Secondary
BHT	1	Tertiary
1,2 Benzenediol o,o diethoxy carbonyl	1	Unknown origin
Benzoic acid 4-ethoxy ethyl ester	1	Tertiary
3,5-cyclohexadiene-1,2dione 3,5bis[,1,1- dimethyl ethyl]	1	Secondary
Pentanoic acid 5 hydroxy 2,4di-t-butylphenylester	1	Primary
3,5-di-tert-butyl-4-hydroxybenzaldehyde	1	Unknown origin
4[4-methyl [1,3,2] dioxaborinan	1	Unknown origin

Future Work

The Samples of monsoon and winter are already collected and summer - 2017 samples will be collected to check reproducibility of the compound. After collection of summer samples followed by GC-MS analysis of monsoon, winter and second summer samples, the compounds will be compared and frequency of occurrence of volatile organic compounds will be determined. In order to have a better understanding of the season specificity of compounds, samples from the same subjects has been collected in all seasons. Analysis of these compounds will throw light on the consistency of the compounds and reproducibility of the results.

iii. Has the progress been according to original plan of work and towards achieving the objective. if not, state reasons: **Yes**

iv. Please indicate the difficulties, if any, experienced in implementing the project. **Since the field work and sample collection is over, I would request to re-appropriate the travel grant to hiring. As three season samples is still remaining for GC-MS analysis from IIT-Powai**

v. If project has not been completed, please indicate the approximate time by which it is likely to be completed. A summary of the work done for the period (Annual basis) may please be sent to the Commission on a separate sheet. **Project will be completed in stipulated time.**

vi. If the project has been completed, please enclose a summary of the findings of the study. One bound copy of the final report of work done may also be sent to University Grants Commission. **Not applicable**

vii. Any other information which would help in evaluation of work done on the project. At the completion of the project, the first report should indicate the output, such as (a) Manpower trained (b) Ph. D. awarded (c) Publication of results (d) other impact, if any. **Not applicable**

PRINCIPAL INVESTIGATOR **REGISTRAR/PRINCIPAL**

(Seal)