Correspondence Analysis on Spices Research in the Asian Countries

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Abstracts

This paper attempts to identify the high and low activity areas of Spices Research amongst the 36 Asian countries. This analysis is spread over a period of three decades 1968 – 2002 using *HORT – CD* (Horticultural Science) data base. The major focus of this paper is to priorities the research interests. Subject trends, gaps and similarity of research efforts amongst the Asian scholars working in this field. Using correspondence analysis, the relationship between countries versus Spices Research and the dynamics of changes in research priorities, if any, during the study period are being highlighted. Results and implications of this analysis are presented and discussed directing towards policy Makers.

Introduction

Scientific activity is not the result of spontaneous activity of unseen researchers but the consequence of the use of economic resources devoted to funding research teams. These areas are estimated as important for keeping the competitiveness of national economics, they are of strategic importance and therefore it is essential that sparse financial resources of a country be concentrated towards them. Identification of critical areas of Science and Technology is therefore vital for a country so, that proper resource allocation be directed towards them. Publication profile in a field, subfield is an indicator of the scientific activity of a country. Thus publication output properly normalized and collected over different time periods can identify the importance of a research area.

Correspondence Analysis is a technique, which analyses a structure of values after correcting for the marginal frequencies. Correspondence Analysis is a method of factoring categorical variables and displaying them in a property space, which maps their association in two or more dimensions. It is a special kind of canonical Correlation Analysis.

In the present paper attempt is made to identify the area of Spices and study research profile of countries in these areas. Further significant contributions of countries in these fields are identified. Using correspondence analysis, the structure of multivariate relationship between countries and these Spices areas of research are revealed. Cross National comparisons are done for obtaining the countries having similar research directions, important contributors and other related research characteristics.

Mapping is a way to monitor the production of researchers in a particular S & T field. A map represents the internal structure of a field. The maps are enhanced with information about the countries, institutes or researchers active in the identified areas. The results of the mapping analysis are presented on paper to the users, particularly, the Policy Makers.

Spices, mentioned in the Vedas, and Bible, have occupied an important place in the lives of people since ancient times. They have been considered indispensable in seasoning of foods, flavouring of beverages, in perfumery, cosmetics and medicines. Spices are as "Products of plant origin for seasoning food to give flavour and aroma". Chambers Dictionary defines as "aromatic and pungent vegetable substances used as condiments and for seasoning food". The American Spices Trade Association (ASTA) defines spice as "any dried plant product used primarily for seasoning purpose". The Spices Board, Ministry of Commerce and Industry, Govt. of India, Cochin, Kerala has categorized spices into 52 kinds under five broad categories in terms of their origin, features, and component principles present in them. The five categories are Major, Seed, Tree, Herbal and Other Spices. The 52 spices are distributed amongst these categories.

Objectives
The objectives of this study are three folds.
- A focus on Cross – Country analysis in the field of Spices Research.
- To quantify the total number of papers published on Spices vs Countries.
- To analyse the R&D priorities on Spices amongst the Asian countries at the cross-national level for the period of 35 years (1968-2002)

Materials & Methods
HORT–CD database, published by CABI (Centre for Agricultural Bioscience International), UK, London being one of the world's leading English language abstracting and indexing services on this subject has been chosen to be the source

database of this study. An attempt has been made to establish correlation between the three chosen categorical variables Asian Countries, Spices and Study period. Hence, the dataset corresponds to a 3D system formed of the cube: 36 Asian Countries X 5 Categories of spices X 35 years of Study period. The matrix focuses on the 5 categorization of Spices X 36 Asian countries with the intention of deriving the main correlation between these two study fields over the entire 35 years span time.

The Data Tables 1 refer to the quantum of records for each of the top ten Asian countries against the five categories of spices selected for the purpose of cross-national analysis of productivity pattern in the Asian region. These tables were run for Correspondence Analysis using DTM software.

Data and Text Mining (DTM) software devoted to exploratory analysis of multivariate numerical and textual data, developed in 2004 by L.Lebart in collaboration with M. Becue and A. Salem was adopted to apply the Correspondence analysis for mapping the data to observe the relationship between 'Countries versus Spices and the dynamic changes in research priorities, if any, during the study period..

Observations

The findings of this study are presented in this paper in the form of mapping the graphical display in Figures 1, Map of Asian Countries vs Spices and Figure 2 Map of Year vs Spices Categories.

Correspondence Analysis (Countries vs Spices Categories)

The total literary output from the 36 Asian countries for the whole study period, 1968 to 2002, includes 17,918 records. This data is shown in Data Table 1 and presented in a two-way contingency table with two variables - Spices categories (5 groups) and Cross-countries (Top10 groups only).

Table 1: Spices Categories vs Countries for 1968-2002.

Country	Major	Seed	Tree	Herbal	Other Spices	Total
Ind	5052	1403	558	238	4047	11298
Jap	732	73	55	110	283	1253
Chi	749	72	19	14	180	1034
Kor	850	23	30	27	55	985
Isr	375	81	1	108	80	645
Tur	207	45	5	61	106	424
Tai	277	16	10	7	38	348
Indo	208	2	86	2	33	331
Pak	115	28	11	9	112	275
OAC	735	94	103	56	337	1325
Total	9300	1837	878	632	5271	17918

Table 1A: Eigenvalues

```
  eigenval      perc    cumul     histogram  of  values


1 .07275       55.67    55.67    ******************************************************
2 .03812       29.17    84.84    ****************************
3 .01838       14.07    98.90    **************
4 .00143        1.10   100.00    **
```

It should be noted that first dimension is very dominant, accounting for 56% of the total inertia.

Table 1B: Coordinates and Contributions 1968-2002

```
------------------------------------------------------------------------------------------------------
iden         weight dist/o*           coordinates      *  absolute contribution  *  relative contribution    *
**************************************************************************************************************
               *   f1    f2    f3    f4    f5  *  f1   f2   f3   f4   f5  *  f1   f2   f3   f4   f5  *
**************************************************************************************************************

Active column-points


Major         .519    .05 *   .22   .07   .05   .00   .00 * 33.1  6.6  8.4   .0   .0 *  .86  .09  .05  .00  .00 *
Seed          .103    .11 *  -.28  -.15   .04  -.10   .00 * 10.8  6.0  1.1 71.8   .0 *  .69  .20  .02  .09  .00 *
Tree          .049    .45 *  -.09   .43  -.51  -.02   .00 *   .5 23.2 69.6  1.7   .0 *  .02  .40  .58  .00  .00 *
Herbal        .035   1.03 *   .49  -.82  -.33   .02   .00 * 11.9 62.7 20.6  1.2   .0 *  .24  .66  .10  .00  .00 *
Other Spices  .294    .11 *  -.33  -.04   .01   .04   .00 * 43.7  1.4   .3 25.2   .0 *  .97  .02  .00  .01  .00 *


Active row-points


Ind           .631    .03 *  -.18   .00   .02  -.01   .00 * 29.3   .0  1.0  2.6   .0 *  .99  .00  .01  .00  .00 *
Jap           .070    .12 *   .28  -.16  -.10   .09   .00 *  7.5  4.7  4.0 38.5   .0 *  .64  .21  .09  .06  .00 *
Chi           .058    .17 *   .31   .15   .23  -.02   .00 *  7.8  3.4 16.3  1.0   .0 *  .57  .13  .30  .00  .00 *
Kor           .055    .49 *   .64   .23   .18   .00   .00 * 30.8  7.5  9.5   .0   .0 *  .83  .11  .06  .00  .00 *
Isr           .036    .65 *   .49  -.62  -.12  -.11   .00 * 11.9 36.2  3.0 31.1   .0 *  .37  .59  .02  .02  .00 *
Tur           .024    .37 *   .24  -.54  -.14   .04   .00 *  1.8 18.3  2.4  2.1   .0 *  .15  .79  .05  .00  .00 *
Tai           .019    .31 *   .48   .20   .19  -.01   .00 *  6.2  2.1  3.7   .3   .0 *  .75  .13  .11  .00  .00 *
Indo          .018   1.17 *   .30   .74  -.73  -.07   .00 *  2.3 26.4 53.6  5.6   .0 *  .08  .46  .45  .00  .00 *
Pak           .015    .06 *  -.22  -.07   .01   .11   .00 *  1.0   .2   .0 12.7   .0 *  .74  .07  .00  .18  .00 *
OAC           .074    .04 *   .11   .08  -.13   .03   .00 *  1.3  1.2  6.3  6.0   .0 *  .36  .17  .44  .03  .00 *
```
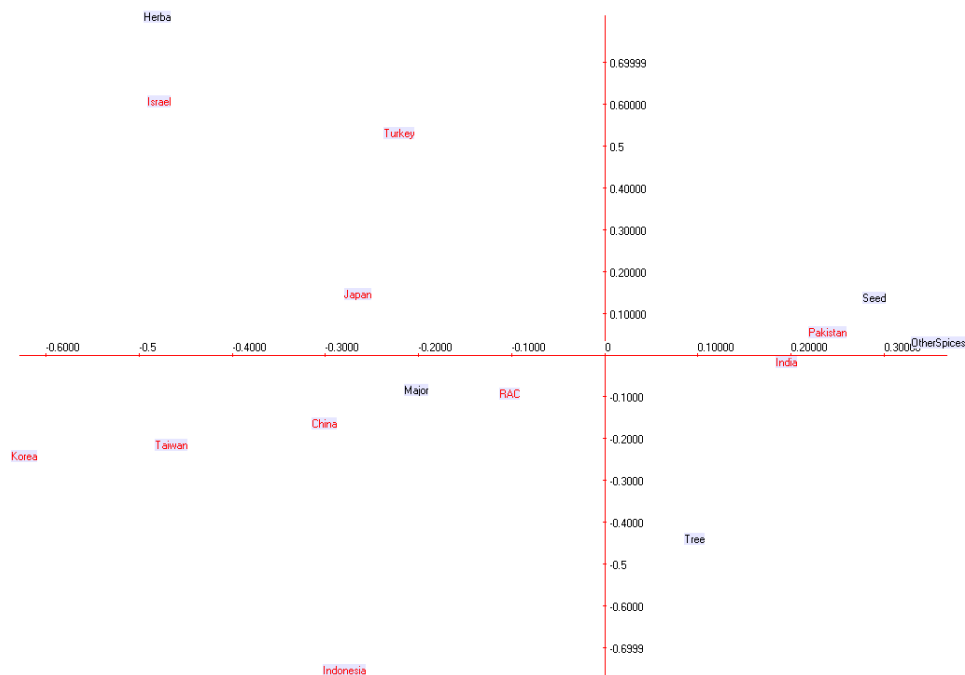

Figure 1: Asian countries vs Spices categories for 1968-2002

- 'Major' and 'Herbal' Spices are in 'Positive' with the highest coordinate of 33.1% points for 'Major Spices'; 'Seed', 'Tree' and 'Other Spices' are in Negative side with 43.7 % points for 'Other Spices'.
- With reference to countries, China, Japan, Korea, Turkey, Taiwan, Israel, Indonesia, OAC are with the Positive contribution, while, India, and Pakistan are with the Negative contribution. Amongst the positive contributions, Korea ranks high with 30.8% value and amongst the Negative, India ranks with 29.3% value.

Further analyses on the relationship amongst these Asian nations versus Spices reveal the following:
- Korea (30.8%), Israel (11.9%), China (7.8%), Japan, (7.5%), Taiwan (6.2%), Indonesia (2.3%), Turkey (1.8%) and OAC (1.3%) are associated with the 'Major' and 'Herbal Spices'.
- India (29.3%) and Pakistan (1.0%) are associated with the 'Other Spices', 'Tree' and 'Seed Spices'.

It can be identified that during the study period, the top 10 countries against their R&D output on Spices are as follows:

Korea	Major Spices
India	Other Spices
Pakistan	Seed and Tree Spices
Israel	Herbal Spices
China	Herbal Spices
Japan	Herbal Spices
Taiwan	Herbal Spices
Indonesia	Herbal Spices
Turkey	Herbal Spices
OAC	Herbal Spices

Hence, it can be inferred that 'Herbal Spices' is the most significant category of spices of Asian research.

Chronological Analysis of R&D Output on Spices
An attempt has been made to assess the quantum of records chronologically to identify the focus of RD status on Spices research during the block periods of the study period from 1968-2002.

Table 2: Quantum of Spices vs Year

Year	Major	Seed	Tree	Herbal	Other Spices	Total
1968-72	156	43	8	5	86	298
1973-77	890	158	75	31	364	1518
1978-82	955	174	88	58	491	1766
1983-87	1147	227	121	68	714	2277
1988-92	1773	372	145	111	1081	3482
1993-97	2074	372	223	164	1261	4094
1998-02	2305	491	218	195	1274	4483
Total	9300	1837	878	632	5271	17918

Table 2A: Eigenvalues

```
     eigenval     perc    cumul      histogram of values

1.  00298       55.68     55.68  ********************************************************
2.  00129       24.13     79.81  ************************
3.  00099       18.46     98.27  ******************
4  .00009        1.73    100.00  **
```

It should be noted that first dimension is very dominant, accounting for 56% of the total inertia.

Table 2B: Coordinates and Contributions –Spices vs Year

```
------------------------------------------------------------------------------------------------
iden          weight dist/o*        coordinates     *   absolute contribution  *  relative contribution    *
*************************************************************************************************************
                      *   f1    f2    f3    f4    f5 *  f1    f2    f3    f4    f5 *  f1    f2    f3    f4    f5  *
*************************************************************************************************************

Active  column-points

Major         .519   .00 *  .04  -.01   .00   .00   .00 * 30.4   6.0    .7  11.0    .0 *  .91   .08   .01   .01   .00 *
Seed          .103   .01 *  .03   .05   .06  -.02   .00 *  3.7  19.9  37.7  28.4    .0 *  .15   .33   .49   .03   .00 *
Tree          .049   .01 * -.03  -.09  -.05  -.03   .00 *  1.7  27.6  11.1  54.7    .0 *  .09   .63   .19   .09   .00 *
Herbal        .035   .04 * -.15  -.10   .11   .01   .00 * 26.0  26.0  39.4   5.1    .0 *  .51   .22   .26   .00   .00 *
Other Spices  .294   .01 * -.06   .03  -.02   .00   .00 * 38.2  20.5  11.0   1.0    .0 *  .75   .17   .07   .00   .00 *

Active  row-points

1968-72       .017   .04 *  .15   .15   .05  -.02   .00 * 36.1  30.9   5.0   4.9    .0 *  .26   .65   .08   .01   .00 *
1973-77       .085   .03 *  .15  -.03  -.02   .00   .00 * 36.1   4.1    .0    .0    .0 *  .95   .03   .02   .00   .00 *
1978-82       .099   .00 *  .04  -.02  -.01   .01   .00 *  5.0   3.6    .9   6.9    .0 *  .70   .22   .04   .03   .00 *
1983-87       .127   .00 * -.02   .02  -.04  -.02   .00 *  2.3   4.9  20.4  50.1    .0 *  .18   .17   .53   .12   .00 *
1988-92       .228   .00 * -.05  -.03  -.02   .00   .00 * 18.0  12.4  10.8   3.3    .0 *  .67   .20   .13   .00   .00 *
1993-97       .194   .00 * -.01   .05   .00   .01   .00 *   .6  37.0    .0  29.1    .0 *  .04   .91   .00   .05   .00 *
1998-02       .250   .00 * -.01  -.02   .05   .00   .00 *   .9   6.5  58.8   5.7    .0 *  .04   .12   .83   .01   .00 *
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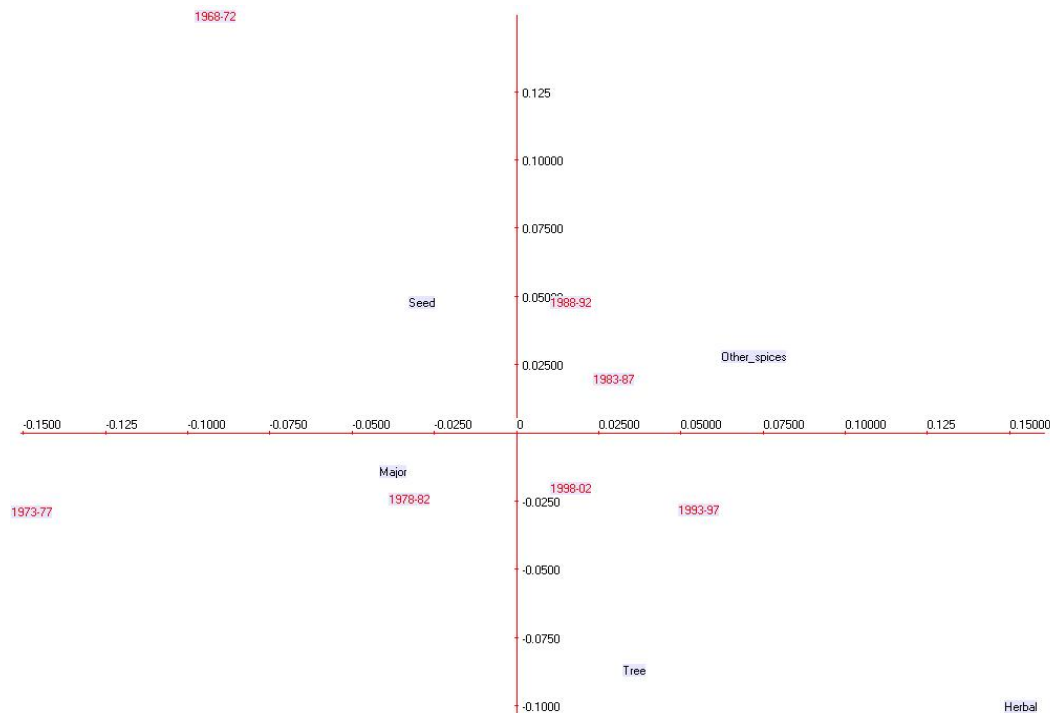
Figure 2: Year vs Spices Categories 1968-2002

- 'Major' and 'Seed Spices' are 'Positive' with the highest coordinate of 30.4% points; 'Tree', 'Herbal' and 'Other Spices' are in the Negative side, with 38.2% points for 'Other Spices'.
- With reference to years, 1968-1972, 1973-1977, 1978-1982 are with the Positive contribution, while 1983-1987, 1988-1992, 1993-1997, 1998-2002 are with the Negative contribution.
- Amongst the Positive contributions, 1968-1972 & 1973-1977 rank high with 36.1% value and amongst the Negative, 1993-1997 ranks with 18% value.

Further analyses on the relationship amongst these Asian nations versus Spices reveal the following:
- 1968-1972 (36.1%), 1973-1977 (36.1%), 1978-1982 (5%) are associated with the 'Major Spices' and 'Seed Spices'.
- 1993-1997 (18%), 1983-1987 (2.3%), 1998-2002 (0.9%) and 1988-1992 (0.6%) are associated with 'Other Spices', 'Tree' and 'Herbal'.

Hence, the following can be inferred regarding the productivity pattern vs year:

1968-1972	Major Spices
1973-1977	Major Spices
1978-1982	Seed Spices
1983-1987	Herbal Spices
1988-1992	Other Spices
1993-1997	Tree Spice
1997-2002	Tree Spices

Conclusion

Cross-national assessment is done for understanding the similarity of research priorities of Asian countries. Significant changes in research profiles of countries are also depicted through this study. Asian continent undoubtedly is a prime producer and publisher of literature on Spices research. India tops the rank list among the Asian countries. This paper analyses and also reveals that over the period of time, the R&D output is more on 'Tree Spices', although in 1970s 'Major Spices' had been the focus of interest. Next to India, Indonesia, and Korea are emerging as major contributors to Spices literature in the Asian region.

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