Consumers Caring Health with End Products (Ayurvedic Medicines) Containing *Neopicrorhiza scrophulariiflora* in Nepal

Research Article

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Abstract

*Neopicrorhiza scrophulariiflora* (Pennell) D. Y. Hong is an endangered herbaceous medicinal plant found in subalpine and alpine zone of eastern Himalayas comprising Sikkim, Nepal, Bhutan and China. Rhizomes of *Neopicrorhiza scrophulariiflora* (hereinafter referred to as *Neopicrorhiza*) have medicinal properties and are highly traded in Nepal, India and China. Information on driving factors for demand of *Neopicrorhiza* from consumer perspective is unknown, knowledge of which is important because it can allow insights into future demand and sustainability of future trade. In this context, a survey was conducted among purchasers and consumers (patients) of end products (Ayurvedic medicines) containing *Neopicrorhiza* (n=513) in five different cities of Nepal from March to July 2017 using structured questionnaire to explore characteristics of consumers and consumption of end products of *Neopicrorhiza*. The utilization of Ayurvedic medicines containing *Neopicrorhiza* for treatment of health disorders of human is prevalent in Nepal. Men and women patients of diverse ages and with different socio-economic profiles were found to consume Ayurvedic medicines containing *Neopicrorhiza* to treat health disorders associated with different organ systems of body. The patients receiving Ayurvedic medicines containing *Neopicrorhiza* were children, adults and elders ranging from 1 to 98 years old (av. 37.6 years). Employed and unemployed, educated and illiterate consumers were found to consume Ayurvedic medicines containing *Neopicrorhiza* to treat their health disorders in Nepal. Patients receiving those medicines were from households having diverse annual cash income levels. The purchase and consumption of Ayurvedic medicine containing *Neopicrorhiza* was most often guided by a doctor’s prescription. Most of the respondents believed that the prices of those Ayurvedic medicines were fairer than other types of medicines. Similar studies are recommended in other countries like India and China where the *Neopicrorhiza* is exported from Nepal.

Keywords: *Neopicrorhiza*, purchasers, consumers, characteristics, health disorder, Ayurvedic medicines

Introduction

For most of the world's population, plants, based on many well-established systems of medicine, in either crude or extract form, represent the foundation of primary health care for the foreseeable future (1). Current evidence indicates that a huge number of people rely on medicinal plant products to maintain their health or treat health disorders, and that this number is unlikely to decrease in the foreseeable future (2). Thousands of species of plants are used in traditional and modern medicine throughout the world, and many more species are important to the growing market for plant-based cosmetics, essential oils, food, beverages and other products, representing by far the biggest use of the natural world in terms of number of species (3, 4, 5, 6, 7, 8). Herbal medicines have long been used for the prevention and treatment of a wide range of medical conditions, as well as for general health enhancement (9, 10, 11).

*Neopicrorhiza scrophulariiflora* (Pennell) D. Y. Hong, Scrophulariaceae family, (hereinafter referred to as *Neopicrorhiza*) is an endangered medicinal herb found in the subalpine as well as alpine zone of the eastern Himalayas comprising Sikkim, Nepal, Bhutan and China (13,14). *Neopicrorhiza*, locally called *Kutki*, is assessed as being vulnerable in Nepal (15). Its dry rhizomes have been used for healing for centuries, which has become a commercial medicinal plant product nowadays. Nepal is estimated to supply 66 ± 12% of *Neopicrorhiza* rhizomes in global supply chain (16). In Nepal, about 1,800 species, including *Neopicrorhiza* are currently in use for production of Ayurvedic, Unani, and Siddha medicines (17) and also for essential oils, cosmetics, aromatic foods and perfumes (18). Some studies have indicated a rising demand for Himalayan plant based medicinal and cosmetic products (19, 20) that will foster demand of raw materials, hence could lead to rise in harvest level of this species. The volume of medicinal plants traded from Darchula District of far-western Nepal in the fiscal year 2014-15 was 401 tons with a harvester value of USD 5.5 million, representing a 2.3 fold increase in

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volume and 17.2 fold increase in value compared to 1997-98 (55). Commercial gathering of selected medicinal plant species to meet increasing national and international market demand can result in over-exploitation (12). Ghimire et al. (21) reported that the size class of rhizomes of Neopicrorhiza harvested for trade was significantly smaller than those collected for health care, leading to premature harvesting. The trade may pose sustainability threats that are best understood by combining species-level biophysical, trade, and consumer studies (55). Despite the high levels of trade, information about the consumers and consumption of the end products of Neopicrorhiza is lacking in literature, hence leaving an information gap on what drives its demand. Obtaining product-level knowledge of demand drivers is a key research gap, closing it would allow us to more accurately predict trade changes and associated concerns, such as what species are likely to need (more) protection. There is not a single consumer survey study available for any of the species traded from Darchula District of far-western Nepal including Neopicrorhiza, and hence the factors determining the demand for any of these species remain unknown (55). Knowledge on consumption of medicinal plant products is essential for prediction of future demand of species and planning for sustainability of harvesting. The aim of this paper is to contribute for an understanding of the consumer characteristics and consumption of end products of commercially important medicinal plants by exploring the prevalence of consumption of the Ayurvedic medicines containing Neopicrorhiza in Nepal. Ayurvedic medicines in this study refer to finished herbal medicines that contain as active ingredients, parts of plants, or other plant materials, or combinations, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental disorders.

Materials and Methods

The research was based on inductive social approach (56, 57) that begins with detailed observations of the world using social research methods, which moves towards more abstract generalizations and ideas, rather than applying hypothesis or theory. Three large cities from terai region (Butwal, Bharatpur, Birgunj) and two large cities from mid hill region (Gorkha headquarter and Kathmandu) were randomly selected for consumer study. Data were collected through consumer surveys in five cities of Nepal from March to July 2017. Face to face interviews were conducted using structured questionnaire with purchasers of the Neopicrorhiza-containing Ayurvedic medicine/s in Ayurvedic pharmacies on the spot. Prior consent was taken with respondents before the interview. Nineteen enumerators working in the Ayurvedic pharmacies having good knowledge on the ingredients of the medicines were mobilized for surveys. These enumerators were able to identify the Ayurvedic medicine in which Neopicrorhiza was present as an ingredient, so they conducted interviews to those who purchased only those medicines. The list of Ayurvedic medicines containing Neopicrorhiza used in this research is available in Kafle et.al., (53). One hundred one (101) purchasers of Neopicrorhiza-containing Ayurvedic medicines were surveyed in Bharatpur (19.7%), 12 in Birgunj (2.3%), 167 in Butwal (32.6%), 52 in Gorkha Headquarter (10.1%), and 181 in Kathmandu (35.3%). In total, 513 purchasers were surveyed: a) 280 in terai and b) 233 in mid hill.

The main tool for the data collection was a structured questionnaire, finalized after pre testing and was composed of three main sections. Section one of the questionnaire included demographic characteristics of the respondents mainly sex, age, education, household annual cash income and belief on price and side effects of the Ayurvedic medicines. Section two included demographic characteristics of the patients or consumers mainly sex, age, education and occupation. Section three included characteristics related to consumption of Neopicrorhiza-containing Ayurvedic medicines mainly name of the medicine, prescription status, combination with allopathic medicine, belief on the price and side effects of the medicine, annual (past year’s) expense on the medicine and quantity of the medicine purchased for consumption. The questionnaire is available in Smith-Hall et al. (51).

The research did not require approval of ethics from government of Nepal since it was a pure academic research mainly based on non-invasive and non-destructive methods (i.e. interviews) with full anonymity of the respondents. In this study, the respondents refer to purchasers of the Ayurvedic medicine/s containing Neopicrorhiza and the consumers refer to patients who will consume the purchased Ayurvedic medicine/s containing Neopicrorhiza, starting consumption within 24 hours from the time of purchase. The words ‘consumer’ and ‘patient’ are used interchangeably in this paper. The words ‘respondent’ and ‘purchaser’ are used interchangeably in this paper.

Data were analyzed using IBM Statistics SPSS 20. Descriptive statistics including frequency, percentage, mean, standard deviation as well as inferential statistics including binomial test and Chi square test were used. As we did not know about the population containing respondents, non-parametric tests were chosen for inferential analysis. One sample Chi square and binomial test were used to examine the statistical differences in different categories of the variables. Association of demographic variables with consumer’s preference for prescribed versus non prescribed Neopicrorhiza products was examined using Chi square test. Association of health disorder type and age of the consumers was examined with Chi square test. Nepali Rupees (NRs) was converted into United States Dollar (USD) using the rate specified on 29 February 2018: 1 USD = 103.50 NRs according to Central Bank of Nepal (22).

Results

Characteristics of purchasers of Ayurvedic medicines containing Neopicrorhiza (respondents)

Characteristics of the respondents are summarized in table 1. The respondents comprised of 60.4% male and 39.6% female. Out of 513 respondents who participated in this study, the highest age frequency (n=320; 62.4%) was between 26 to 50 years of age, and
the lowest age frequency (n=4; 0.8%) was above 75 years of age. The mean age of the respondent was 36.5±12.9 years. The highest education frequency (n=145; 28.3%) was intermediate and equivalent level and the lowest education frequency (n=25; 4.9%) was postgraduate and above. The respondents had different annual household cash income level. Most of the respondents (n=168; 32.7%) had annual household cash income of USD 966.19 to 1932.37 while the lowest number of respondents (n=48, 9.4%) had that of USD 2898.56 to 3864.73.

Table 1 Characteristics of purchasers of Ayurvedic medicines containing Neopicrorhiza (respondents)

| Variable                      | Frequency | Percentage |
|-------------------------------|-----------|------------|
| **Sex**                      |           |            |
| • Males                       | 310       | 60.4       |
| • Females                     | 203       | 39.6       |
| **Age (years)**               |           |            |
| • Up to 25                    | 117       | 22.8       |
| • 26-50                       | 320       | 62.4       |
| • 51-75                       | 72        | 14.0       |
| • Above 75                    | 4         | 0.8        |
| **Education**                 |           |            |
| • Illiterate                  | 32        | 6.2        |
| • Primary                     | 58        | 11.3       |
| • Lower secondary             | 29        | 5.7        |
| • Secondary                   | 47        | 9.2        |
| • SLC and equivalent          | 80        | 15.6       |
| • Intermediate and equivalent | 145       | 28.3       |
| • Graduate and equivalent     | 97        | 18.9       |
| • Postgraduate equivalent and above | 25 | 4.9 |

Table 2 Consumption rate of the Ayurvedic medicines containing Neopicrorhiza adopted by consumers

| Neopicrorhiza products | Number of responses | % responses | % cases | Rank |
|------------------------|---------------------|-------------|---------|------|
| Rohitkyadi Churna      | 131                 | 17.7        | 25.5    | 1    |
| Pilarin                | 109                 | 14.7        | 21.2    | 2    |
| Mahayograj Guggal      | 83                  | 11.2        | 16.2    | 3    |
| Kasarin                | 59                  | 8.0         | 11.5    | 4    |
| Nimbadi                | 48                  | 6.5         | 9.4     | 5    |
| Arogvavardhini i Vati  | 38                  | 5.1         | 7.4     | 6    |
| MVLiv                  | 30                  | 4.0         | 5.8     | 7    |
| Piles Cure Oil         | 29                  | 3.9         | 5.7     | 8    |
| Hepatop                | 25                  | 3.4         | 4.9     | 9    |
| Asthamarin             | 23                  | 3.1         | 4.5     | 10   |
| Livherb                | 23                  | 3.1         | 4.5     | 11   |
| Mana                   | 20                  | 2.7         | 3.9     | 12   |
| Kumaryasava            | 17                  | 2.3         | 3.3     | 13   |
| Glowderm               | 14                  | 1.9         | 2.7     | 14   |
| Vata Raktahar Churna   | 14                  | 1.9         | 2.7     | 15   |
| Livosave               | 13                  | 1.8         | 2.5     | 16   |
| Sarivadyasava          | 12                  | 1.6         | 2.3     | 17   |
| Jivan Shakti Prash     | 10                  | 1.3         | 1.9     | 18   |
| Pittaghnna             | 9                   | 1.2         | 1.8     | 19   |
| Livotop                | 7                   | 0.9         | 1.4     | 20   |

SLC = School Leaving Certificate (to be received after successful completion of 10 years of school level education in school in Nepal)
Exchange rate: 1 USD = 103.50 Nepali Rupees (NRs) as of 28 February 2018 according to Central Bank of Nepal (22)

Consumption of Neopicrorhiza-containing Ayurvedic medicines

In total, 513 respondents were interviewed using structured questionnaire who purchased at least Ayurvedic medicine containing Neopicrorhiza. 361 respondents (70.4%) purchased only one Neopicrorhiza-containing Ayurvedic medicine, 75 respondents (14.6%) respondents purchased two Neopicrorhiza-containing Ayurvedic medicines, 53 respondents (10.3%) purchased three Neopicrorhiza-containing Ayurvedic medicines and 24 respondents (4.7%) purchased four Neopicrorhiza-containing Ayurvedic medicines to be consumed by the patients.

A total of 30 Ayurvedic medicines that contain Neopicrorhiza as an ingredient were found purchased for consumption by the consumers. Those medicines and the number of consumers consuming particular medicine is presented in table 2. Rohitkyadi Churna, Pilarin, Mahayograj Guggul, Kasarin, Nimbadi Churna, Arogyavardhini Vati, MVLiv, Piles Cure Oil, Hepatop, Asthamarin and Livherb are the top Ayurvedic medicines containing Neopicrorhiza in terms of intention for consumption, with Rohitkyadi Churna in first number.
The consumers were categorized into two groups according to their preference to the consumption of prescribed or over the counter (OTC) products/medicines: consumers who prefer prescribed *Neopicrorhiza*-containing Ayurvedic medicines were considered as “guided consumers”, consumers who prefer over the counter (OTC) *Neopicrorhiza*-containing Ayurvedic medicines were considered as “free consumers”. 382 (74.5%) of the consumers had preference to prescribed *Neopicrorhiza* products, i.e. they were guided consumers. Consumer in this study refers to patient who will consume the purchased Ayurvedic medicine/s containing *Neopicrorhiza*, starting consumption within 24 hours from the time of purchase.

### Characteristics of consumers (patients)

Out of the 513 patients, 286 (55.8%) were male. The mean age of patients was 37.6±16.6 years. The patients ranged from 1 to 98 years of age. 267 (52.0%) patients were between 26 to 50 years of age, while 10 (2%) were above 75 years of age. The highest education frequency (n=118; 23.0%) was intermediate level and the lowest education frequency (n=21; 4.1%) was postgraduate and above. The household of the patients had different annual cash income level. Most of the patients (n=168; 32.7%) had annual household cash income of USD 966.19 to 1932.37 while the lowest number of patients (n=48, 9.4%) had that of USD 2898.56 to 3864.73 (Table 3).

Out of the total patients, 382 (74.0%) were about to consume *Neopicrorhiza*-containing Ayurvedic medicines prescribed by an Ayurvedic doctors or health workers. Only 30 (6%) patients were about to *Neopicrorhiza*-containing Ayurvedic medicines in combination with allopathic medicine. All groups of patients including businessmen, farmers, job holders, students, housewives and unemployed persons preferred *Neopicrorhiza*-containing Ayurvedic medicines for their healthcare. Businessmen represented the highest consumers (n=126; 24.5%) while unemployed persons represented the lowest occupation frequency (n=9; 1.7%) (Table 3).

| Neopicrorhiza products | Number of responses | % of responses | % of cases | Rank |
|------------------------|--------------------|--------------|------------|------|
| Tonoliv                | 6                  | 0.8          | 1.2        | 21   |
| Lacchadi Oil           | 5                  | 0.7          | 1.0        | 22   |
| Jameda Churna          | 4                  | 0.5          | 0.8        | 23   |
| Maha Sudarshon Churna  | 4                  | 0.5          | 0.8        | 24   |
| Livorin                | 3                  | 0.4          | 0.6        | 25   |
| Hepadex                | 2                  | 0.3          | 0.4        | 26   |
| Hepagard DS            | 1                  | 0.1          | 0.2        | 27   |
| Livergen               | 1                  | 0.1          | 0.2        | 28   |
| Megaferol              | 1                  | 0.1          | 0.2        | 29   |
| Yakrit Rasayan Churna  | 1                  | 0.1          | 0.2        | 30   |
| Grand Total            | 742                | 100          | 144.6      |      |

52 respondents believed that the price of Ayurvedic medicines containing *Neopicrorhiza* was low (6.8%), 267 respondents believed that it was high (34.9%), and 447 believed that it was fair (58.4%).

### Table 3 Characteristics of patients (consumers) of *Neopicrorhiza*-containing Ayurvedic medicines

| Variable                               | Frequency (% | Chi Square/ Binomial (Goodness of fit) | p-value |
|----------------------------------------|--------------|----------------------------------------|---------|
| Sex                                    |              |                                        |         |
| Males                                  | 286 (55.8)   |                                        | 286     | 0.010* |
| Females                                | 227(44.2)    |                                        |         |
| Age (years)                            |              |                                        |         |
| Upto 25                                | 136 (26.5)   |                                        |         |
| 26-50                                  | 267 (52.0)   |                                        |         |
| 51-75                                  | 100 (19.5)   |                                        |         |
| Above 75                               | 10 (2.0)     |                                        |         |
| Education                              |              |                                        | 115.19  | 0.000* |
| Illiterate                             | 50 (9.7)     |                                        |         |
| Primary                                | 87 (16.9)    |                                        |         |
| Lower secondary                        | 30 (5.9)     |                                        |         |
| Secondary                              | 48 (9.4)     |                                        |         |
| SLC and equivalent                     | 81 (15.8)    |                                        |         |
| Intermediate and equivalent            | 118 (23.0)   |                                        |         |
| Graduate and equivalent                | 78 (15.2)    |                                        |         |
| Postgraduate equivalent and above      | 21 (4.1)     |                                        |         |
| Household income (cash) NRs/ year      |              |                                        |         |
| 0 to 966.18                            | 88 (17.2)    |                                        |         |
| 966.19 to 1932.37                      | 168 (32.7)   |                                        |         |
| 1932.38 to 2898.55                     | 84 (16.4)    |                                        |         |
| 2898.56 to 3864.73                     | 48 (9.4)     |                                        |         |
| 3864.74 to 4830.92                     | 58 (11.3)    |                                        |         |
| Above 4830.92                          | 67 (13.1)    |                                        |         |
| Was the medicine prescribed by a doctor? |            |                                        |         |
| Yes                                    | 382 (74.0)   |                                        | 382.00  | 0.000* |
| No                                     | 131 (26.0)   |                                        |         |
| Belief regarding price of the *Neopicrorhiza* product |     |                                        |         |
| Cheap                                  | 39(7.6)      |                                        |         |
| Fair                                   | 293(57.11)   |                                        | 188.22  | 0.000* |
| Expensive                              | 181(35.28)   |                                        |         |
Health disorders of patients for which Neopicrorhiza-containing Ayurvedic medicine was purchased

The Ayurvedic medicines containing Neopicrorhiza were used to treat disorders related to Circulatory system, Digestive system, Hepatobiliary system, Immune system, Integumentary system, Muscular system, Nervous system, Reproductive system, Respiratory system, Skeleton system and Urinary system (Table 4). Highest number of patients (174, 33.29%) had digestive system disorders to treat using Ayurvedic medicines, followed by disorders associated with hepatobiliary system, respiratory system, integumentary system, skeleton system, circulatory system, muscular system, immune system, nervous system, urinary system and reproductive system in chronological order.

Table 4 Health disorder types for which Neopicrorhiza-containing Ayurvedic medicine was used

| Disorder type                  | Frequency | Percentage |
|-------------------------------|-----------|------------|
| Circulatory system            | 32        | 6.24       |
| Anemia                        | 4         |            |
| Blood impurity                | 5         |            |
| Broken blood vessel           | 1         |            |
| Diabetes                      | 5         |            |
| Heartburn                     | 2         |            |
| High blood pressure           | 8         |            |
| Hyperuricemia (High Uric Acid)| 7         |            |
| Digestive system              | 174       | 33.92      |
| Abdominal pain                | 11        |            |
| Abdominal swelling            | 2         |            |
| Hepatobiliary system          | 85        | 16.57      |
| Gallstones (Cholelithiasis)   | 1         |            |
| Hepatitis                     | 1         |            |
| Jaundice                      | 36        |            |
| Liver disorder                | 43        |            |
| Fatty liver                   | 4         |            |
| Immune system                 | 17        | 3.31       |
| Asthenia (weakness)           | 15        |            |
| Health maintenance            | 1         |            |
| Underweight                   | 1         |            |
| Integumentary system          | 52        | 10.14      |
| Acne vulgaris (pimple)        | 4         |            |
| Age spots                     | 2         |            |
| Pruritus (itchy skin)         | 13        |            |
| Psoriasis (reddish, scaly rash on skin) | 1    |            |
| Skin allergy                  | 31        |            |
| Tinea/Ringworm infection/ Eczema | 1       |            |
| Muscular system               | 26        | 5.07       |
| Burning legs                  | 1         |            |
| Edema (muscle swelling)       | 3         |            |
| Fever                         | 4         |            |
| Myalgia (muscle pain)         | 12        |            |
| Myalgia and Edema numbness in body | 1     |            |
| Numbness in body and My-algia | 1         |            |
| Numbness in hands and legs    | 2         |            |
| Numbness in knee              | 1         |            |
| Nervous system                | 9         | 1.75       |
| Eating disorder               | 1         |            |
| Fatigue                       | 7         |            |
| Obesity                       | 1         |            |
| Reproductive system           | 5         | 0.97       |
| Leucorrhoea (whitish vaginal discharge) | 2       |            |
| Metrorrhagia (irregular menstruation) | 2 |          |
| Uterine problem               | 1         |            |
| Respiratory system            | 67        | 13.06      |
| Asthma                        | 14        |            |
| Chronic bronchitis            | 2         |            |
| Chronic cough                 | 5         |            |
| Cough                         | 23        |            |
| Cough and common cold         | 9         |            |
| Cough and fever               | 7         |            |
| Itchy throat                  | 1         |            |
| Pneumonia                     | 2         |            |
| Sinusitis                     | 4         |            |
The consumption of medicinal plant products. The study entry point for future studies concerning the characteristics of Nepalese consumers consuming end products of Neopicrorhiza is lacking in the scientific literature. In this context, it is believed that this study reveals the characteristics of Nepalese consumers consuming end products containing Neopicrorhiza and may serve as an entry point for future studies concerning the consumption of medicinal plant products. The study approach might be useful for replicating similar studies in future.

Children are encouraged to use herbs for their nutritional values to facilitate normal or healthy growth and development; young persons for their euphoric effects, supply essential ingredients to help them cope with daily stress and to prevent or slow the onset of aging; older persons for their anti-aging or rejuvenating effects and women for slimming and beauty enhancing effects (54). Our study showed that children, adults and elders ranging from 1 to 98 years old (av. 37.6 years) consumed Ayurvedic medicines containing Neopicrorhiza in Nepal. The number of consumers was found increasing up to 40 years of age but after that decreasing. However, analyzing consumers with 10 years of age interval, the number of respondents of two age categories: 21-30 years and 31-40 years were found with more consumers: 119 and 133 respectively than other age groups. Our findings are consistent with some previous research findings. Du et al. (24) found that use of herbal medicine declines along with increasing age in Germany. Arcury et al. (25) and Ness et al. (26) found that older American individuals did not favor the use of herbal medicine. Thorsen and Pouliot (28) found age as significant determinant of use of traditional medicine in mid hill region of Nepal. The traditional medicine was primarily relied on by middle-aged individuals from relatively uneducated households who were living in villages with limited allopathic medicine service provision (29). It is argued that herbal remedies are likely to be used by the relatively young users (30). The respondent age correlated inversely with the use of herbal supplements among older Americans (26). Arcury et al. (25) found that herbal remedy use declined with age. But in the case of patients with diabetes, previous studies showed contrasting results. Egede et al. (27) found that older age is associated with higher likelihood of using Complementary and Alternative Medicine among people living with diabetes. Older participants were likely to use complementary and alternative medicine in people with type 2 diabetes in Taiwan (31). It might be due to need for long term adherence of older persons to specific medicines for treating specific disease.

We found that both educated and illiterate people consumed Ayurvedic medicines containing Neopicrorhiza in Nepal. The majority of the consumers were educated; only 9.7% consumers were illiterate. However, the education levels of the consumers were significantly different (p-value=0.000). Our findings on consumption of Ayurvedic medicines by both literate and illiterate persons, and higher number of literate consumers were consistent with findings of a number of previous researches. Educational level was key determinant of herbal medicinal product use in Germany (24). Egede et al. (27) and Bell et al. (32) found that having a higher educational background is associated with a higher likelihood of using Complementary and Alternative Medicine among people living with diabetes. Education was identified as significant determinant of use of traditional medicine in mid hill region of Nepal (28). Nur (30) argued that herbal remedies are likely to be used by those with

| Disorder type                  | Frequency | Percentage |
|-------------------------------|-----------|------------|
| Skeleton system               | 40        | 7.80       |
| Rheumatoid Arthritis          |           |            |
| Urinary system                |           |            |
| Dysuria (painful urination)   | 6         | 1.17       |
| Nephrolithiasis (kidney stones)| 4         |            |
|                               | 2         |            |

The names of disorders were adopted from (23).

### Association of demographic variables with patient’s preference for prescribed versus non prescribed Neopicrorhiza-containing Ayurvedic medicines

Association was found between patient types in terms of preference to consumption of prescribed or non-prescribed medicines and location (cities) (p=0.001), consumption of particular Ayurvedic medicine (p=0.000), occupation of the patient (p=0.023) (Table 5). No association was found between patient types in terms of consumption of prescribed or non-prescribed medicines and annual household cash income, quantity of Ayurvedic medicine purchased for consumption, amount of total expense in Ayurvedic medicine in past 12 months, consumption of the Ayurvedic medicine with other types of medicine, belief of the patient on the price of the Ayurvedic medicine, sex of the patient, age of the patient and education level of the patient.

### Table 5 Association of demographic variables with patient’s preference for prescribed versus non prescribed Neopicrorhiza-containing Ayurvedic medicines

| Variables                        | Chi square | p-value |
|----------------------------------|------------|---------|
| Age                              | 63.077     | 0.855   |
| Sex                              | 0.039      | 0.844   |
| Education level                  | 13.330     | 0.064   |
| Occupation                       | 12.9888    | 0.023*  |
| Annual household cash income     | 8.542      | 0.129   |
| Combination of Ayurvedic medicine with allopathic medicine | 0.021 | 0.884 |
| Belief of the patient on the price of the Ayurvedic medicine | 2.711 | 0.258 |
| Expense on the product during last 12 months | 98.514 | 0.078 |

* p < 0.05 is considered as statistically significant.

### Discussion

This research has provided important insights into the consumption of end products containing Neopicrorhiza in Nepal, based on research conducted in five large cities of Nepal. Research on consumer characteristics and consumption of end products of Neopicrorhiza is lacking in the scientific literature. In this context, it is believed that this study reveals the characteristics of Nepalese consumers consuming end products containing Neopicrorhiza and may serve as an entry point for future studies concerning the consumption of medicinal plant products. The study

**Published online in http://ijam.co.in**

**ISSN: 0976-5921**
higher education. Ness et al. (26) found that advanced education correlated with fewer chiropractic visits and more dietary and herbal supplement and personal practices use. Education was one of the significant predictors of herb use among older American adults (25). Education did not demonstrate any relationship to complementary and alternative medicine use in people with type 2 diabetes in Taiwan (31). Education often promotes beliefs and ideas that clash with local traditions in developing countries and are associated with a reduction in the use of indigenous herbal/animal medicine (33).

It is found that people from households having diverse annual cash income consumed Ayurvedic medicines containing Neopicrorhiza in Nepal. The income levels of the consumers were significantly different (\(p=0.000\)). About half of the consumers had annual household cash income level USD 966.19 to 2898.55, while only 17.2% consumers had this income level below USD 966.19. Nepal's average monthly household income is USD 277.83 from 2006 to 2015 (34). We found that around two third of the consumers had annual household cash income level below Nepal's average monthly household income. The average annual expenditure on Neopicrorhiza-containing Ayurvedic medicine per consumer is only USD 14.8. In Ghana, traditional medicine use was predicted by having low-income levels (35). Sato (36) found that rising income was associated with decreased use of traditional care. Khan et al. (37) and UN Millennium Project (38) reported that the rich are more likely to utilize modern healthcare. Owing to their greater means to access. High income was an important determinant of use of traditional medicine, challenging the common assumption that poor and marginalized people are most reliant on traditional medicine due to its availability (28). In Taiwan, income did not demonstrate any relationship with traditional and alternative medicine use in people with type 2 diabetes (31). In our study, preference to prescribed or non-prescribed Neopicrorhiza-containing Ayurvedic medicine was not significantly associated with annual household cash income level of the consumer (\(p=0.778\)).

Our results showed that both employed and unemployed people consumed Ayurvedic medicines containing Neopicrorhiza in Nepal. The occupation of the consumers is diverse: business, farmer, housewife, salaried job and student. The share of unemployed consumers was low (1.7%). Nature of occupation (being a trader) was found predictive of traditional medicine use in Ghana (35). In Taiwan, employment status did not demonstrate any relationship to complementary and alternative medicine use in people with type 2 diabetes (31). In our study, preference to prescribed or non-prescribed Neopicrorhiza-containing Ayurvedic medicine was found significantly associated with occupation of the consumer (\(p=0.023\)), with highest number of consumers as being businessmen (126; 91 taking prescribed medicines and 35 taking non-prescribed ones) and lowest as being unemployed (9).

Ayurvedic medicinal plant products are most convenient and have greater acceptance amongst the users due to their easy availability, easy biodegradability, economic cost, mankind and environment friendly nature both and minimum side effect (52). In this study, most respondents believed that the prices of Ayurvedic medicines containing Neopicrorhiza are fairer than other types of medicines. One of the factors that hindered herbal medicine use among Ghanaian adults included high cost of herbal products at credible herbal clinics (41).

We found that the Ayurvedic medicines containing Neopicrorhiza were used by patients having a number of health disorders associated with Circulatory system, Digestive system, Hepatobiliary system, Immune system, Integumentary system, Muscular system, Nervous system, Reproductive system, Respiratory system, Skeleton system and Urinary system in Nepal. However, there is variation in the number of patients with specific disorders receiving these medicines. We found highest share of patients having abdomen related disorders (259, 50.49%) receiving Neopicrorhiza-containing medicines and the lowest share of patients having reproductive system disorders (5, 0.97%) receiving these medicines. It should be noted that the patients might receive other Ayurvedic medicines together with Neopicrorhiza-containing Ayurvedic medicines for the treatment of their health disorders, so we could not generalize about priority of disease types which Neopicrorhiza-containing Ayurvedic medicine is effective for. But our study confirmed the diseases to which Neopicrorhiza-containing Ayurvedic medicines were used for healing. Previous studies had explored the use of the raw (unprocessed) Neopicrorhiza rhizomes to treat various ailments such as liver disorders, fever, asthma, jaundice and have pharmaceutical value for hepatoprotective, immunomodulator and antiatherosclerotic activities (42, 43, 44) in Indian, Bhutanese, Tibetan and Chinese traditional medicines. Medicinal values of Neopicrorhiza are due to the presence of irridoid glycosides such as picroside I and II, and kutkoside (45, 46, 47, 48, 49). An in vitro study suggested antithymatitis B-like activity of Neopicrorhiza through reduction in the levels of surface antigens (50).

**Conclusion**

This research presents a first exploration of consumption of the Ayurvedic medicines containing Neopicrorhiza and consumer characteristics in Nepal. The consumption of Ayurvedic medicines containing Neopicrorhiza is prevalent in Nepal. These medicines are consumed by children, adults and elders of households having diverse annual household cash income levels. Both illiterate and educated persons prefer these medicines. Majority of the patients prefer to consume medicines after receiving prescription from Ayurvedic doctors and professionals. Major proportions of the patients believe that the price of the Neopicrorhiza-containing medicines is fairer than other types of medicines. Majority of the patients did not combine Neopicrorhiza-containing Ayurvedic medicines with allopathic medicines. Neopicrorhiza-containing Ayurvedic medicines are commonly used to treat health disorders related to Circulatory system,
Digestive system, Hepatobiliary system, Immune system, Integumentary system, Muscular system, Nervous system, Reproductive system, Respiratory system, Skeleton system and Urinary system. The first three health disorders for which more patients receive Ayurvedic medicines containing *Neopicrorhiza* for treatment were digestive system disorders, hepatobiliary system disorders, and respiratory system disorders. Looking at the multiple uses of Ayurvedic medicines containing Kutki and consumers of diverse socio-economic background, it is speculated that the domestic demand of these medicines, therefore of dry rhizomes of *Neopicrorhiza* for manufacturing of those medicines, could rise in future. Similar consumption studies are recommended in India and China where the *Neopicrorhiza* from Nepal is exported, so that driving factors of demand for this species at regional level is identified. The consumption of the end products of Neopicrorhiza was driven by the preference of consumers towards Ayurvedic methods for treatment of health disorders. So further research is recommended to explore why the consumers choose to use Ayurvedic medicines for their healthcare.

**Conflicts of Interest**

The authors declare that there are no conflicts of interest regarding the publication of this paper.

**Acknowledgement**

We acknowledge the Agriculture and Forestry University and the Research Committee for Development Research (FFU) of the Danish Ministry of Foreign Affairs, Grant No. 13-07KU, the "Transiting to Green Growth: Natural Resources in Nepal" project for scholarship and financial support for this research. We are highly grateful to the enumerators for assisting in data collection. We express our sincere gratitude for the consumers of diverse socio-economic background regarding the publication of this paper. We are highly grateful to Prof. Dr. Carsten Smith-Hall and Dr. Mariève Pouliot of University of Copenhagen; Dr. Suresh Kumar Ghimire of Tribhuvan University of Nepal; Prof. Dr. Abhoy Kumar Das of Federation of Community Forestry Users, Nepal (FECOFUN); and Prof. Jay Prakash Dutta, Prof. Dr. Naba Raj Devkota, Prof. Dr. Bhumina Devkota, Prof. Dr. Balam Bhatta and Dr. Shiva Chandra Dhakal of Agriculture and Forestry University of Nepal for providing advice on different stages of study. Specifically, Dr. Mariève Pouliot of the University of Copenhagen provided comments on its initial draft and assisted during preparation of questionnaire.

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