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Consumption and conservation practices adopted while using LPG for cooking in urban households of Ernakulam city

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Abstract
Today, Liquefied Petroleum Gas (LPG) has become an unavoidable part of the urban households. Irrespective of the fact whether it be low/middle/high income family, they perceive cooking gas or LPG in the category of must spend or an unavoidable expenditure. This paper, based on a primary survey conducted among 500 urban households, analyses the extent of use of LPG and the conservation practices adopted for conserving LPG. The study found out a knowledge gap in conserving LPG during cooking and identifies a need for popularizing conservation techniques to conserve LPG, which is a non-renewable energy source.

Keywords: liquefied petroleum gas (LPG), fuel consumption, fuel conservation, cooking, urban households

Introduction
The average urban Indian consumes different forms of energy from the conventional biofuel to the modern liquefied petroleum gas and electricity. Majority of the urbanites depend on LPG and electricity for cooking unlike their counterparts in rural and semi-urban areas rely on kerosene, biomass energy and LPG. LPG has been preferred over biomass and kerosene due to its compactness (comes in liquified form), ease in availability, ease of use, high fuel efficiency etc. Even though LPG prices have been spiraling upward in the last decade, even the rural households are migrating to this most modern efficient fuel. In villages even with plenty of biomass available whether in the form of firewood, hay or sawdust, there is a growing tendency among the rural populace to avoid its use and switch over to LPG. There are quite a few reasons for this: - 1) LPG is being subsidized and made available to the low-income groups. With the launching of Pradhan Mantri Ujjwala Yojana scheme on 1st May 2016 (The Hindu, 2016) [8]. LPG has become the dominant fossil fuel for cooking in domestic sector. 2) There is a huge migration of the new generation village folk to the cities. The older generation who stay back in the villages no longer have the luxury of getting help for odd jobs like collecting firewood, hay etc., as in olden times. Storage and consumption of these conventional fuels have also become cumbersome. The new generation who have migrated to the cities and who have got a taste of the luxuries and efficient equipment that they have access to had a shift in their thought processes. They want their parents who are left behind in the villages also to have a taste of these luxuries. LPG use is one such classic example of this mind shift.

This widespread popularity across the masses of varying income and demographic levels have resulted in a possible misuse of this precious energy form, with an average growth rate of 8.4 per cent in LPG consumption, making India the second-largest consumer of LPG in the world at 22.5 million tones (Vyas and Pareek, 2016) [9]. Fossil fuels like LPG are finite and cannot be recreated (Kumar and Vimala, 2016) [5]. If all the people depend solely on this non-renewable energy resource, the planet's reserves will be totally exhausted in a few years. Thus, there is a growing need of conserving this depleting energy form, if it is to be made available to the future generations. .

Relevance of the study

In the domestic sector, rapid pace of urban life and increasing disposable income has led to greater purchasing power and paved way to possession and use of Liquefied Petroleum Gas (LPG) for simplifying mundane tasks. Liquefied Petroleum Gas is one among the non-renewable energy resources, which needs conservation. The threat of depletion of these non-renewable energy resources along with an alarmingly high increase in their usage has necessitated the need for nurturing energy conserving culture in every walk of life. The present study is an attempt to understand the consumption and conservation practices adopted by urban homemakers in conserving this precious fuel in the domestic sector.

Objectives of the study

- To find out the extent of use of LPG among urban households
- To understand the conservation practices among the homemakers while using LPG
- To comprehend the advantages and limitations of LPG from the opinion of the respondents

Methodology

The present study is a baseline survey where the investigator collects data from 500 urban households. The study locale is Ernakulam city, which is purposively chosen for the study due to its unique status in the state with regard to urbanization. Ernakulam city has the maximum population with a wide range of income, living conditions and socio-economic background. The population of the city comprises both resident and migrant, the blue collared and white collared, small entrepreneurs and rich business tycoons thus providing a wide spectrum of users with varied habits of consumption. Hence the study area was found relevant to understand the nature, extent and magnitude of energy usage of the urban households. The tool used for the study was a structured interview schedule. Sample were selected randomly from the population. The study would throw light on fuel consumption pattern of urban households, with focus on LPG.

Results of the Study

Results of the study throw light on various type of fuel used by the urban households for cooking, conservation techniques practiced for reducing LPG consumption and opinion of the respondents regarding advantages and limitations of using LPG.

Energy Sources of the Households

The choices people make about what and how much energy they use in the day to day life will have an impact on the environment, their lives as well as the lives of the future generations; hence this aspect of energy consumption has been studied. The types of fuels chosen by the urban households and whether it is used as primary or secondary fuel, is listed in Table 1.

Table 1: Fuel used by the Urban Households for Cooking

Pattern of Use	Percentage of Households* (n= 500)				
	LPG	Electricity	Firewood	Kerosene	Biogas
Primary fuel	98.2	Nil	1.6	Nil	0.2
Supplementary fuel	1.2	32.6	9.8	2.8	1.2
Total	99.4	32.6	11.4	2.8	1.4

*Multiple response

With increasing disposable income and changes in lifestyles, as reported by Dzioubinski and Chipman (1999) [2], households tend to move from the cheapest and least convenient fuels (biomass) to more convenient and normally more expensive ones (charcoal, kerosene) and eventually to the most convenient and usually the most expensive types of energy (LPG, natural gas, electricity). Affordability is the major factor driving consumers' choice of fuels for domestic purposes (ESMAP, 2003) [3]. Accessibility is an added factor governing the choice of energy sources in the domestic sector. The table reveals that 99.4% of the families were relying on LPG with 98.2% using it as primary source and the remaining 1.2% families using it as supplementary fuel. All the 500 houses surveyed were electrified but not a single urban household was using electricity as the primary cooking fuel. On gaining popularity of induction stoves and microwaves, 32.6% of the households were using electricity as a supplementary source, especially when supply of LPG is delayed and during emergency situations. Ten percent of the respondents reported using firewood as a supplementary cooking fuel. Other energy sources such as kerosene and biogas were found to be the least popular cooking fuels of urban households.

The analysis of the survey results revealed that electricity followed by LPG were the most common fuels of urban households. The observation supports the prediction of the 'ladder of fuel preferences' theory propounded by Cai and Jiang (2008) [1] which points out that energies used in urban households are more convenient, cleaner, and more efficient than those used in rural areas, where biomass and coal are the common fuels. A study conducted by Tata Energy Research Institute (TERI) reports that urban India opts to cleaner and convenient cooking fuels as LPG, marketed in portable cylinders to light the fire in over 59% of the urban Indian kitchens (Kumar, 2018) [4].

Conservation techniques practiced for reducing LPG consumption

LPG price hike every day coupled with its shortage causes much inconvenience to homemakers. Planning the work wisely by adopting efficient conservation techniques, can reduce the consumption of LPG to a great extent and this in turn will lead to reduction in expenditure of fuel. Table 2 depicts the conservation practices followed by the homemaker to reduce energy consumption.

Table 2: Conservation Techniques Practiced to Reduce LPG Consumption

Conservation Techniques	Frequency (n=500)	Percentage*
Use of pressure cooker	279	56
Cooking in low flame, once food reaches boiling temperature	253	50.6
Covering with the cooking vessel with lid	249	49.8
Keeping raw materials ready before lighting the stove	182	36.4
Selection of right sized cookware	135	27
Using optimum water for cooking	128	25.6
Prompt cleaning of the burner	67	13.5
Use of flat-bottomed vessels	65	13
Pre-soaking of pulses and cereals	64	12.8
Use of thermal cooker	47	9.4
Use of copper-bottomed cooking vessels	17	3.4
Supplementing with biogas	5	1
Using hot water from solar cooker	1	0.2

*Multiple responses

Pressure cooking is one of the fastest and most economical ways of cooking. Experiments have shown fuel savings of 20% on rice, 46% on soaked gram dal and 41.5% on meat, as compared to ordinary cooking (PCRA, 2018) [6]. Saving in cooking time with use of a pressure cooker was 70% more than that of conventional cooking techniques. To obtain further savings from a pressure cooker, separators could be used to cook different items such as rice, vegetable and dal, simultaneously. In the present study 56% of the respondents were following this technique.

When the contents reach boiling point, a low flame is enough to keep it boiling. Experiments conducted have revealed a saving of 25% fuel when the flame was reduced after boiling had started (PCRA, 2018) [6]. Keeping the flame raised at the boiling stage causes further evaporation of the liquid without serving any useful purpose. Hence, when water or any other liquid is boiling, lowering the flame when it starts to boil will reduce fuel consumption. More than half of the respondents (50.6%) were aware of the need for regulating the flame while cooking. This is possible in a gas stove by turning the knob to 'simmer' position.

Covering the utensil with lid while cooking, saves energy and time to a great extent. By doing so, the trapped energy increases efficiency and speeds up cooking. The study reveals that nearly half of the respondents were covering the utensil with lid while cooking. Pre-soaking of pulses and cereals in water for varying intervals reduces energy consumption and speeds up the cooking process. Only 12.8% of the respondents cited pre-soaking of pulses and cereals as a method used for conservation of cooking fuel. Keeping raw materials ready before lighting the stove save LPG wastage, 36.4% of the respondents practice this for conserving LPG.

By selecting right sized utensils for cooking, a small percentage of cooking gas can be conserved. More energy is needed to heat up large utensils and 27% homemakers practiced this method. All raw materials should be kept near the cooking area before lighting the stove; otherwise the utensil gets overheated and much of cooking gas is lost in the process (Prabin, 2015) [7]. Only 36.4% of the respondents in the study sample adhered to this practice. The quantity of water used for cooking differs for various dishes and even for the same dish. An experiment on cooking rice with double the required quantity of water has revealed that fuel consumption increased by 65% (PCRA, 2018) [6]. So, it is best to use only optimum quantity of water for cooking. Among the homemakers, 25.6% followed this technique.

To ensure thermal efficiency of LPG stoves, the gas burners need to be cleaned well and the wicks of the kerosene stove should be trimmed or replaced periodically. Gas burners blocked with soot and charred wicks of a kerosene stove increases fuel consumption (PCRA, 2018) [6]. Only 13.5% of the respondents were regularly cleaning the stoves to promote energy conservation. A visible flame creeping up the sides of the cooking vessel causes wastage of fuel since it gives out heat to the surroundings. Covering the flame as much as possible by using a broad bottomed vessel will save fuel. Through experiments, it has been established that for most stoves, a vessel of 25cm diameter is ideal for cooking (PCRA, 2018) [6]. A vessel of this diameter tends to cover the flame completely where as a narrow vessel cannot. The flame should be lowered so that it does not creep up on the sides of the vessel. Only 13% of the respondents were aware of this energy saving technique and the advantages of using the flat-bottomed vessels for cooking food on electric or gas stoves. Pulses and cereals are most commonly consumed among the sample require longer cooking times and thus consume more cooking fuel (Wood, 2016) [10]. Pre-soaking of pulses and cereals can reduce the cooking time and conserve cooking fuel. But only 12.8% of the respondents practice this conservation technique.

Thermal cooker is a promising solution for reducing cooking energy. It employs retained heat for cooking items like rice by preventing the loss of heat from the food at boiling temperature by conduction, convection or radiation. However, only 9.4% of homemakers were using thermal cookers. Cooking involves heat transfer from burning fuel to the bottom of the cooking vessel. Copper bases enhance the heat transfer effectiveness of the cooking utensils. Among the respondents, 3.4% reported the use of copper-bottomed utensils for cooking. Use of biogas reduces the dependency on LPG and will serve as an efficient solution for waste disposal (Raha, *et al.*, 2014). But its feasibility is limited in urban areas due to lack of space. Using hot water from solar cooker is a better practice for reducing LPG consumption as it will take only less energy for the water to reach the boiling point. This technique is practiced in only one household.

Advantages and Limitations

Fossil fuels are the chief sources of energy which mankind depends on. Preference towards clean and healthier fuel and launch of Pradhan Mantri Ujjwala Yojana scheme made LPG the dominant fossil fuel for cooking in residential segment. Though it has several advantages, its extensive use has a great impact on the environment leading to increased greenhouse gas emission. Table 3 presents the opinion of the respondents regarding advantages and limitations of LPG.

Table 3: Opinion of the Homemakers Regarding Advantages and Limitations of LPG

Responses	Households (n=497)	
	Frequency	Percentage
Advantages felt		
Operational convenience	436	87.7
Ease in thermal control	411	82.7
Conservation of time and effort in cooking	376	75.7
Availability at subsidized cost	321	64.6
Produces no smoke and soot	212	42.7
Limitations experienced		
Price hike	379	76.3
Delays in supply of refills	187	37.6
Subsidized price allowed only for limited number of cylinders	113	22.7

*Multiple responses

The operational convenience (87.7%), absence of soot and smoke in the kitchen (42.7%), ease in regulation of the flame for thermal control which is required to prepare various dishes (82.7%), availability of cylinders at subsidized price (64.6%) and reduction of time and effort in food preparation (75.7%) were the advantages reported by the homemakers. The limitations experienced by the homemakers regarding LPG were the periodical hike in its price, delays in supply of LPG cylinders and restriction of subsidy to limited number of cylinders (9/year/ connection). The homemakers valued LPG as the most convenient cooking fuel, but at the same time they expressed worries over the periodical hike in price of LPG cylinders and delays in supply of refills.

Conclusion

The study revealed that LPG was the most preferred fuel among the households. However only less than half the study sample use effective conservation techniques. This may be due to lack of awareness regarding various conservation techniques among the sample. Various simple and effective technique already adopted by some respondents needs to be popularized among the masses so as to bring about a drastic improvement in the efficient use of LPG.

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