

A comparative study on star rated energy efficient refrigerator

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ABSTRACT

Technical and industrial development makes our life easy. Nevertheless, this advancements and modernization increases the expenditure on resources and goods, to satisfy the human life and make our life comfortable and prestigious. New technologies develop different appliances and equipment for a home to do task conveniently, comfortably and in limited time, but these appliances require energy in the form of electricity, to perform the work. our society is consuming electric energy at such a rate that our sources are being depleted rapidly To reduce the consumption of energy and to increase higher energy efficiency; engineers, technologies and scientists have come up with some innovative ideas introducing something new and better by bringing changes by use of new materials, new designs and new technologies in manufacturing equipment more energy efficient and economic in recent years keeping pace with this energy star products are launched in the market, few years back which are energy efficient as per claimed by the manufacturers. Today's major appliances don't hog energy the way older models do because they must meet minimum federal energy efficiency standards. These standards have been tightened over the years so any new appliances we buy today has to use less energy then the model we are replacing. People should purchase energy efficient equipment when buying new equipment or replacing an old device, choose an energy efficient device with lower consumption. Due to easy access to consumer loans with low interest rates by almost all financial institutions on different household equipment such as refrigerator, air conditioner, television etc, the purchasing power of the homemakers to purchase different household equipment has grown which in turn increases the energy consumption per house hold. To find out the availability of star rated energy efficient household equipment and to study the efficiency and efficacy or star rated refrigerators, the present study was divided into two phases *i.e.* "market survey" and "efficiency and efficacy, field testing experiment". In the first phase, 10 authorized dealers of star rated refrigerators, market survey and in conducting the field experiments during second phase were selected. In all 30 samples of different brands were selected for laboratory experiments.

KEY WORDS : Star rated energy efficient refrigerator, Efficiency, Efficacy, Electricity consumption

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INTRODUCTION

Technical and industrial developments make our life easy. But this advancements and modernization increases the expenditure on resources and goods to satisfy the human life and make our life comfortable and prestigious. New technologies develop different appliances and equipment for a home to do task conveniently, comfortably and in limited time. The major appliances used in our homes are – refrigerator, air conditioner, etc. However, these appliances require energy in the form of electricity to perform the work. But as we use more electricity in our homes, our electricity bills rise. In turn, fossil-fuelled power plants not only generate more electricity, but also more pollution. The continued reliance on depletion of fossil-

fuel resources threaten our energy security. Considered in a broader perspective not only India's electric energy reserves are very limited but also our society is consuming electric energy at such a rate that electric energy is being depleted rapidly. If the current consumption rate is allowed to continue unchecked, electric energy available in our country could exhaust soon. People should purchase energy efficient equipments when buying new equipment or replacing an old device, choose an energy efficient device with lower consumption. Energy star models are the most energy efficient in any product category, exceeding the energy efficient minimums set by federal government as claimed by most of the well-established brands. It has been observed that many energy star

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equipments of different category are available in the market for consumers as per their requirement.

All the manufacturers of star rated household energy efficient equipment claim that these equipments are most efficient and energy saving devices. In the absence of scientific information, many consumers do not want to change the conventional household appliances with low-output ratio, which is a national wastage of electrical energy. Hence, looking at the above, as well as keeping the latest technology for energy conservation in consideration and make the consumer aware about the efficiency and efficacy of star rated household equipment researchers have undertaken the present investigation with the following objectives: to find out the star rated energy efficient household equipment available in market of Udaipur city and to compare the efficiency and efficacy of selected energy efficient refrigerator.

METHODS

Methodological steps, which were followed to achieve the objectives set for the present investigation, are presented under the following two phases:

Phase-1- Market Survey: To get an insight about various star rated energy efficient refrigerator available in market of Udaipur city.

Phase-2- Efficiency and efficacy testing experiment: To compare the various selected models of star rated energy efficient household refrigerator, the experiments were carried out with respect to:

Efficiency of the selected energy efficient refrigerators - Efficiency was measured in terms of electrical energy consumed in kilowatt-hour (KWH).

Efficacy of selected energy efficient refrigerators - Efficacy was measured in terms of performance *i.e.* through achieving and maintaining the temperature of the equipment with relation to refrigerator and outside the equipment in case of air conditioner.

Here it is important to mention that researchers had selected the model of refrigerators with 180 lit. capacity, having single door as sample because it was found to be highest selling model. It was also found that most of middle class families prefer to buy this model due to their affordability (initial cost) and they are the consumers, who are most affected by their monthly electricity bills. Whereas, higher income families prefer to buy double door refrigerator with higher energy consumption of electricity and also not bothered about the electricity bills. To get an authentic data on efficiency and efficacy of selected equipment, each equipment was repeated thrice. Thus, in totality 90 experiments [10(star rated refrigerator) x 3 (randomly selected each category of star rating) x 3

(triplicate reading)] for refrigerator. The experiments on refrigerators were conducted during the month of December, 2009 to January 2010 when the maximum temperature ranged between 19-20°C. All the refrigerators were unused, seal packed (unpacked in front of researchers).

The efficacy of refrigerators was judged by recording temperature in both food compartments as well as in freezer. For this, two digital thermometers were used simultaneously. The thermometers showing the temperature recording through a display window was placed outside on the refrigerator itself and the lead of thermometer was placed in freezer as well as in food compartment. The thermostat was kept on "maximum" (coolest) position to measure the actual energy required by the equipment to reach to its maximum efficacy. The experiment was started at 11:00 a.m. on the day of start of experiment and the reading of energy meter in KWH was recorded to know the unit of electricity consumed in 24 hours. The minimum temperature reached during the whole day by both the food compartment and the freezer was recorded.

OBSERVATIONS AND ANALYSIS

The findings of the present study as well as relevant discussion have been summarized under following heads:

Phase-1- Market survey:

To collect the authentic information during this phase, ten authorized dealers were selected. The researcher self visited the showrooms of these selected dealers and interviewed either the owner or the designated person, in order to gather detailed information regarding the energy efficient refrigerators. The data for availability of energy efficient refrigerators is summarized below in Table 1.

The results of Table 1 show that there were 9 different well known brands namely, LG, Samsung, Videocon, Godrej, Kelvinator, Whirlpool, Electrolux, Haier and Voltas available with star rating from 1-5.

From the interview schedule, it was found that 30 to 40 per cent dealers were selling refrigerator since last 24 months. All the authorized dealers sale SREEHE due to consumer's demand and also due to Government orders to sale energy efficient equipment in which the star rating is available whereas 50 per cent dealers do the same because star rated energy efficient has no complaints of from customers' side and also SREEHE do not require any extra services. Other 50 per cent authorized dealers' sale SREEHE because it acts as sale promotional activity. 60 per cent authorized dealers said that as per the consumers demand refrigerator ranked first in the

Table 1: Frequency distribution of authorized dealers as per the availability of star-rated energy efficient refrigerator in the market of Udaipur (n=10)

Sr. No.	Different brand of refrigerator	Stars rating on equipment with distribution of no. of authorized dealers					No. of authorized dealers	Percentage %
		1 star	2 star	3 star	4 star	5 star		
1.	Life's Good (L.G.)	1	0	0	2	2	3	30
2.	Samsung	0	1	0	5	2	5	50
3.	Videocon	0	0	5	0	0	5	50
4.	Godrej	1	0	0	1	1	1	10
5.	Kelvinator	0	0	1	2	0	2	20
6.	Whirlpool	0	0	3	3	1	3	30
7.	Electrolux	0	0	3	3	0	3	30
8.	Haier	1	0	0	0	0	1	10
9.	Voltas	1	1	0	0	0	1	10

Table depicts multiple responses

preferential order, 70 per cent authorized dealers do not have the knowledge of special features provided in SREEHE, where as 30 per cent dealers were aware of few special features of SREEHE such as energy efficiency, compressor type, thermostat auto cut system, voltage fluctuations, efficient installation, LED technologies etc. All dealers had their experience that SREEHE are energy efficient. 60 per cent dealers felt that SREEHE has high initial price and low operative cost. 30 per cent dealers faced the problem of high initial price while selling these equipments. 50 per cent dealers found that consumers are unaware about the concept of SREEHE. 30 per cent dealers concluded from experience that they themselves had poor convincing capacity. All dealers mentioned that 180 lit. refrigerator with single door was the most popular type/model as they have highest sale over the year.

It can be clearly seen from Table 2 that there were in all six brands having 3, 4 and 5 star rated refrigerators which were selected for testing. Hence, in all ten refrigerators were selected as sample for conducting the

efficiency and efficacy testing experiments. To gather the authentic data, through experiments, among each category, three refrigerators from each brand and each star rating were randomly selected. Hence, in the entire, the total sample comprised of 30 refrigerators for conducting the efficiency and efficacy testing experiment.

Phase 2 : Efficiency and efficacy testing experiment:

The investigators sought the help from an electrician to conduct all the necessary experiments. To judge the efficiency and efficacy of selected equipment, the following parameters were tested:

- Energy consumed in KWH for standard period.
- Temperature reached and maintained in specific period.

From the field testing experiment (Table 3) it can be said that the overall energy consumed (in KWH) was ranging between 0.656 (Whirlpool-5 star) to 1.517 (Videocon-3 star) KWH per day among different selected refrigerators. Over all lowest temperature reached during

Table 2 : Selected sample of star rated energy efficient refrigerator

Brand Dealer	Electrolux	Kelvinator	Life's Good (LG)	Samsung	Videocon	Whirlpool
Dealer 1	0	0	0	0	3 star	0
Dealer 2	3 stars 4 stars	0	4 star 5 star	0	0	4 star 5 star
Dealer 3	0	3 star 4 star	4 star 5 star	5 star	3 star	5 star
Dealer 4	0	0	0	0	3 star	0
Dealer 5	3 stars 4 stars	0	0	0	3 star	0
Dealer 6	0	3 stars	0	5 star	3 star	0
Dealer 7	0	0	0	0	0	5 star
Dealer 8	3 stars 4 stars	0	0	5 star	0	0
Dealer 9	0	0	0	0	3 star	0

Table 3 : Comparative score of efficiency and efficacy of selected star rated refrigerators

Sr. No.	Name of brand	Star rating	Efficiency through energy consumed per day (in KWH)	Efficacy through temperature reached	
				Freezer (in °C)	Food compartment (in °C)
1.	LG	4 Star	0.771	-23.6	2.90
2.	LG	5 Star	0.72	-24.1*	2.74*
3.	Samsung	5 Star	<u>0.711</u>	-22.89	5.53
4.	Videocon	3 Star	1.517	-16.51**	6.66**
5.	Whirlpool	4 Star	0.73	-17.15	3.15
6.	Whirlpool	5 Star	<u>0.656</u>	-18.56	2.98
7.	Kelvinator	3 Star	1.061	-19.54	3.43
8.	Kelvinator	4 Star	0.968	-18.24	3.17
9.	Electrolux	3 Star	1.085	-18.9	4.39
10.	Electrolux	4 Star	0.963	-20.52	3.66

Note: ___Highest efficiency ___Lowest efficiency * Highest efficacy ** Lowest efficacy

Table 4 : Comparative statistical scores for efficiency and efficacy of selected star rated refrigerators

Sr. No.	Brand with star rating	Energy consumption in KWH	Temperature reached	
			Freezer	Food compartment
1.	LG 4 star	0.77*	-23.60*	2.90*
2.	LG 5 star	0.72*	-24.10*	2.74*
3.	Samsung 5 star	0.71*	-25.11*	5.53*
4.	Videocon 3 star	1.51*	-16.51*	6.66*
5.	Whirlpool 4 star	0.71*	-17.14*	3.15*
6.	Whirlpool 5 star	0.66*	-18.55*	2.98*
7.	Kelvinator 3 star	1.06*	-19.53*	3.43*
8.	Kelvinator 4 star	0.93*	-18.23*	3.17*
9.	Electrolux 3 star	1.08*	-18.90*	4.39*
10.	Electrolux 4 star	0.96*	-20.52*	3.66*

* indicate significance of value at P=0.05

a day of freezer was ranging between -16.51°C (Videocon-3 Star) to -24.1°C (LG 5 Star) and lowest temperature reached during a day of food compartment was ranging between 2.74°C (LG 5 Star) to 6.66°C (Videocon-3 star). It is also clear from the table that Whirlpool refrigerator with 5 star rating consumed lowest electric energy *i.e.* 0.656 KWH per day. As far as efficacy is concerned, the LG refrigerator with 5 star rating was having highest efficacy as the temperature in freezers as well as in food compartment was reached to minimum *i.e.* -24.1°C and 2.74°C, respectively. The lowest efficacy was reached by Videocon 3 star with -16.51°C temperature in freezer and 6.66°C temperature of food compartment.

After using ANOVA, there were overall significant differences in efficiency and efficacy at 5 per cent level of significance between and among all selected star rated refrigerators.

Table 4 clearly suggests that after using ANOVA, there were overall significant differences in efficiency and efficacy at 5 per cent level of significance between and among all selected star rated refrigerators.

Conclusion:

When comparison was made between the stars rating of same brand, it was observed that with increased star rating in star rated refrigerators of same brand, efficiency also increased. Similar results were followed with all the brands. Looking at the above findings of research, the investigators can give the generalization that the consumers should purchase star rated household equipments, as they are energy efficient and bears higher efficacy. The results also allow the researchers to give the message to the consumers that looking at their requirements within available budget one can compare the different technical specifications from a wide range of available star rated equipments for their homes.

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