CONTROLLED COOKING TEST (CCT) FOR DIFFERENT TYPES OF FOOD

Background Information

The research experiment was carried out at Sustainable Community Development Services (SCODE) with elevation of 1,923m above sea level and water boiling temperature of 93.6. The data collection was conducted as from 04/08/209 to 14/09/2019. Version 2.0 of the Control Cooking Test was used in this research to assess the performance of the solar electric pressure cookers - DSEPCU (5L of 220w, 300w & 400w; 2.8 of220w) relative to LPG & push and pull stoves. Stoves were compared as they perform a standard cooking task that was closer to the actual cooking that local people do every day. The CCT trials immediately followed each other with three replications. The equipments and materials that were used during experimentation included; cooking pots, weighing scale (At least 6kg capacity and accuracy of 1g), timer, heat resistant gloves, thermometer, fuel, food and water. The initial weight of the stove was recorded and after refilling the fuel into the reactor weight measurements were taken again. The timer was then started at the beginning of experiment and time recorded (initial and the final time taken for cooking). 0.5 kg was the amount of food cooked for each trial and types of food were; githeri, Mokimo, meat, omena, arrow roots, Irish potatoes, sweet potatoes, tea, porridge, green grams, yellow bean, spider plants, boiled maize, ugali, cabbage, chicken, rice, kamande, managu and Matumbo. For the Solar electric pressure cookers, amount of food, power and cooking time was recorded for each trial.

RESULTS AND DISCUSSION

After data collection, analysis of variance and plotting of graphs was conducted showing comparison of time taken and cost of fuel for cooking each food but the ones summarized for this report are Githeri, Irish potatoes, sagget, meat, sweet potatoes, matumbo, yellow beans and rice as shown below;

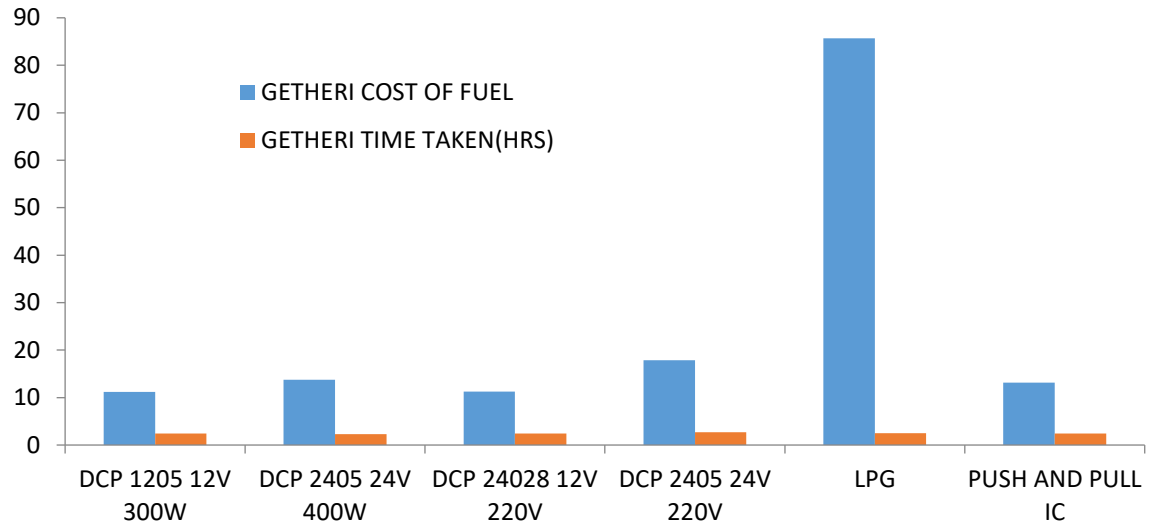

Figure 2.1 Githeri Cost of Fuel and Cooking Tine

It was observed that DCP 2405 24V 400W cooked faster for 2.3hrs however in terms of consumption, DCP 1205 12V 300W consumed the least power which translated to less cash spent. Based on the savings for power consumed, DCP 1205 12V 300W will be the best choice for the end user since the time difference isn't much significant The other SEPC took longer cooking hours above 2.3 hrs and consumed fuel above Ksh 11.2. From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.1 summarizes the sources of variation for samples, columns and interactions within.

Table 2.1 ANOVA for Githeri Cost of Fuel and Cooking Time

Table 2.1 ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	10308.98362	5	2061.7967	47.1041	1.24E-11	2.620654
Columns	11317.41361	1	11317.414	258.5592	2.37E-14	4.259677
Interaction	10305.12656	5	2061.0253	47.08647	1.25E-11	2.620654
Within	1050.505667	24	43.771069			
Total	32982.02946	35				

Figure 2.2 indicates Irish potatoes cost of fuel and cooking time using selected food preparation devices.

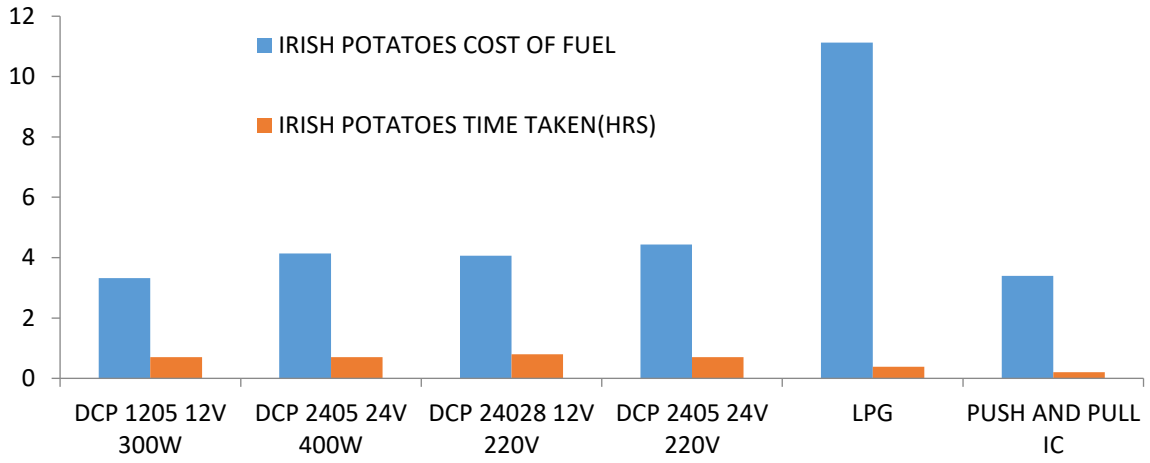

Figure 2.2 Irish potatoes Cost of Fuel and Cooking Tine

DCP 1205 12V 300W was the optimum by using the least amount on cost of fuel and cooking time from the graph. Even though, DCP 1205 24v 400w has the highest power rating, 300w solar

pressure cooker was the best. Push and pull used relatively less power and cooking time however, because of other factors like emissions; it isn't the best choice for the end user. From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.2 summarizes the sources of variation for samples, columns and interactions within.

Table 2.2: ANOVA for Irish potatoes Cost of Fuel and Cooking Time

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	59.94860056	5	11.98972011	35.90331	2.21E-10	2.620654
Columns	233.4070988	1	233.4070988	698.9394	2.93E-19	4.259677
Interaction	72.88384056	5	14.57676811	43.65025	2.81E-11	2.620654
Within	8.014672667	24	0.333944694			
Total	374.2542126	35				

The next food that was cooked was Sagget and a plotted graph showing cost of fuel and cooking time is in figure 2.3. DCP 24028 12V 220V was the optimum by using the least on cost of fuel and cooking time from the graph.

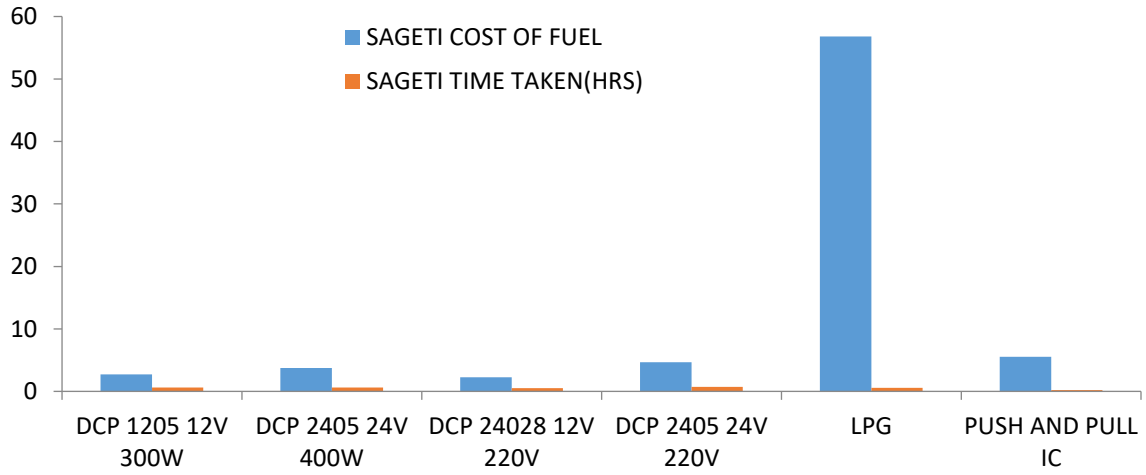

Figure 2.3 Sagget Cost of Fuel and Cooking Tine

From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.3 summarizes the sources of variation for samples, columns and interactions within.

Table 2.3: ANOVA for Sagget Cost of Fuel and Cooking Time

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	3524.438	5	704.8877	1.753334	0.160879	2.620654
Columns	1303.21	1	1303.21	3.241598	0.084373	4.259677
Interaction	3518.736	5	703.7471	1.750497	0.161501	2.620654
Within	9648.649	24	402.027			
Total	17995.03	35				

Meat was also among the food that was cooked in the CCT. The amount was 0.5 kg as the other foods and prepared with three replications. Figure 2.4 summarizes the cost of fuel incurred during cooking and the time used.

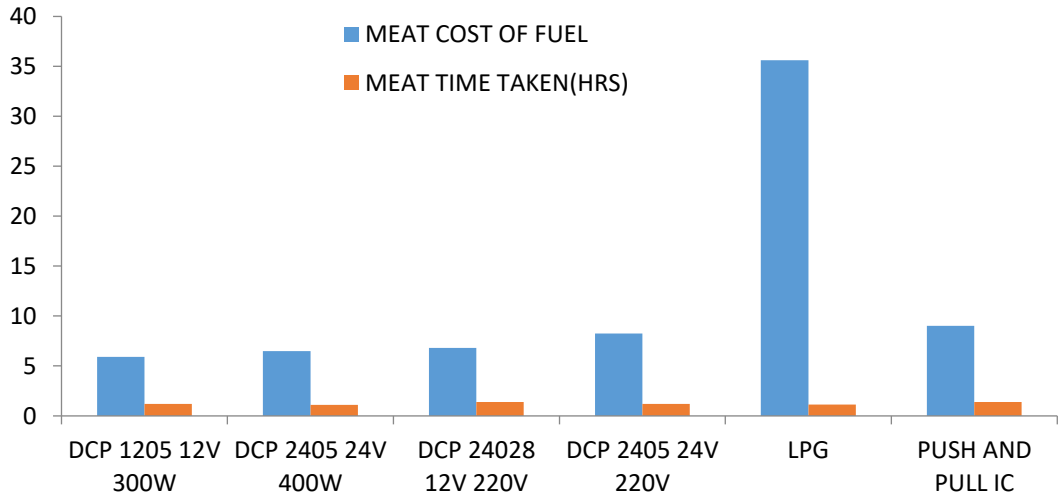

Figure 2.4 Meat Costs of Fuel and Cooking Tine

It was observed that DCP 2405 24V 400W cooked faster for 1.1hrs however in terms of consumption, DCP 1205 12V 300W consumed the least power which translated to less cash spent. The other SEPC took longer cooking hours above 1.2 hrs and consumed fuel above Ksh 6.49. Generally, the solar electric pressure cookers consumed less as compared to LPG and push and pull. From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.4 summarizes the sources of variation for samples, columns and interactions within

Table 2.4: ANOVA for Meat Cost of Fuel and Cooking Time

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	1006.334	5	201.2669	15.61481	7.17E-07	2.620654
Columns	1048.756	1	1048.756	81.3652	3.54E-09	4.259677
Interaction	1019.495	5	203.899	15.81902	6.39E-07	2.620654
Within	309.3477	24	12.88949			
Total	3383.933	35				

Sweet potatoes were also prepared with three replications. Figure 2.5 indicates the cost of fuel and cooking time incurred during the test. It was observed that DCP 2405 24V 400W cooked faster for 0.8 hrs however in terms of consumption, DCP 24028 12V 220V consumed the least power which translated to less cash spent and cooked for 1hr. DCP 2405 24V 300W consumed relatively less but on the higher side. LPG consumed much fuel maybe because it heat faster and requires refilling of the water which takes time to boil again for the cooking process.

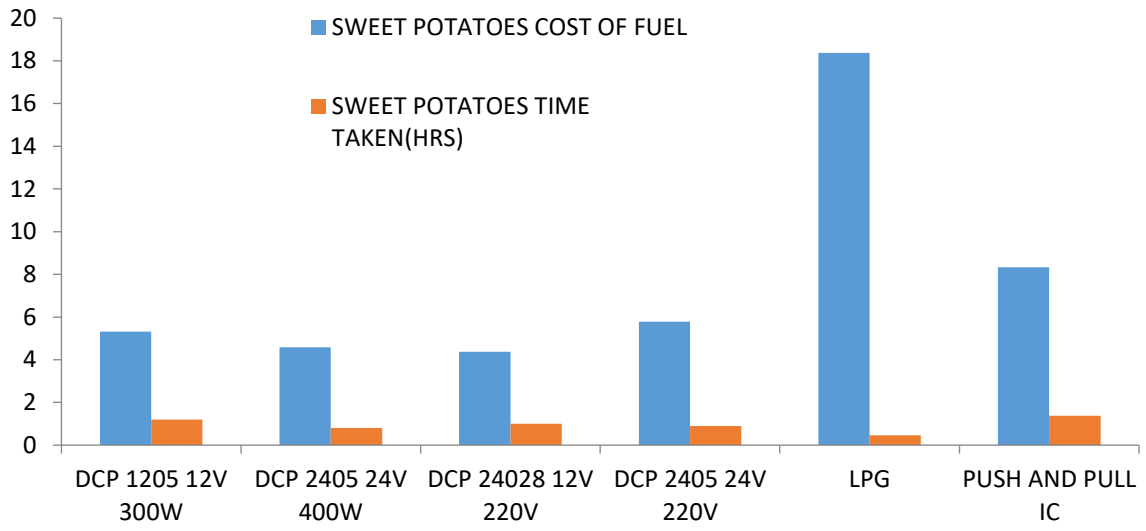

Figure 2.5 Sweet Potatoes Cost of Fuel and Cooking Time

From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.5 summarizes the sources of variation for samples, columns and interactions within

Table 2.5: ANOVA for Sweet Potatoes Cost of Fuel and Cooking Time

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	196.3871	5	39.27741	93.99855	5.85E-15	2.620654
Columns	452.5547	1	452.5547	1083.052	1.75E-21	4.259677
Interaction	230.9058	5	46.18115	110.5206	9.25E-16	2.620654
Within	10.02843	24	0.417851			
Total	889.876	35				

The next on the line was 0.5 kg of Matumbo delicacy. Figure 2.6 shows the cost of fuel and cooking time for preparing 0.5 kg of matumbo. DCP 2405 24V 220V was the best in terms of cooking time. However, DCP 1205 12V 300W consumed the least amount of power translating to less Ksh used.

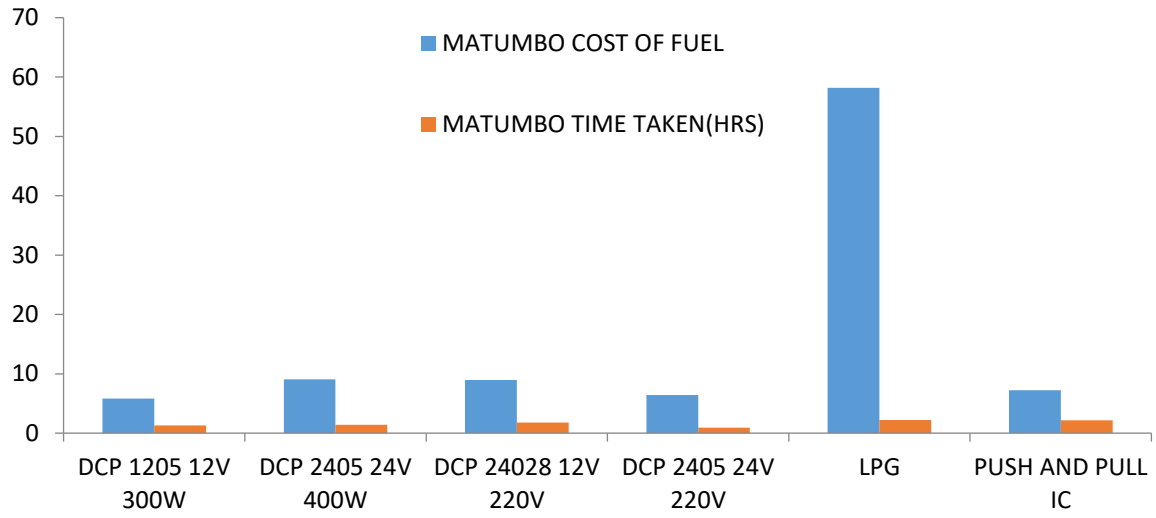

Figure 2.6 Matumbo Cost of Fuel and Cooking Time

From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.6 summarizes the sources of variation for samples, columns and interactions within

Table 2.6: ANOVA for Matumbo Cost of Fuel and Cooking Time

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	3315.626	5	663.1252	130.348	1.39E-16	2.620654
Columns	1842.312	1	1842.312	362.1363	5.52E-16	4.259677
Interaction	3133.181	5	626.6361	123.1755	2.67E-16	2.620654
Within	122.0963	24	5.087346			
Total	8413.215	35				

Last but not least was 0.5kg of yellow beans cooked with three replications. Figure 2.7 shows the average cost fuel and cooking time for yellow beans. It was observed that DCP 2405 24V 400W

cooked faster for 2 hrs however in terms of consumption, DCP 1205 12V 300W consumed the least power which translated to less cash spent and cooked for 2.2 hr.

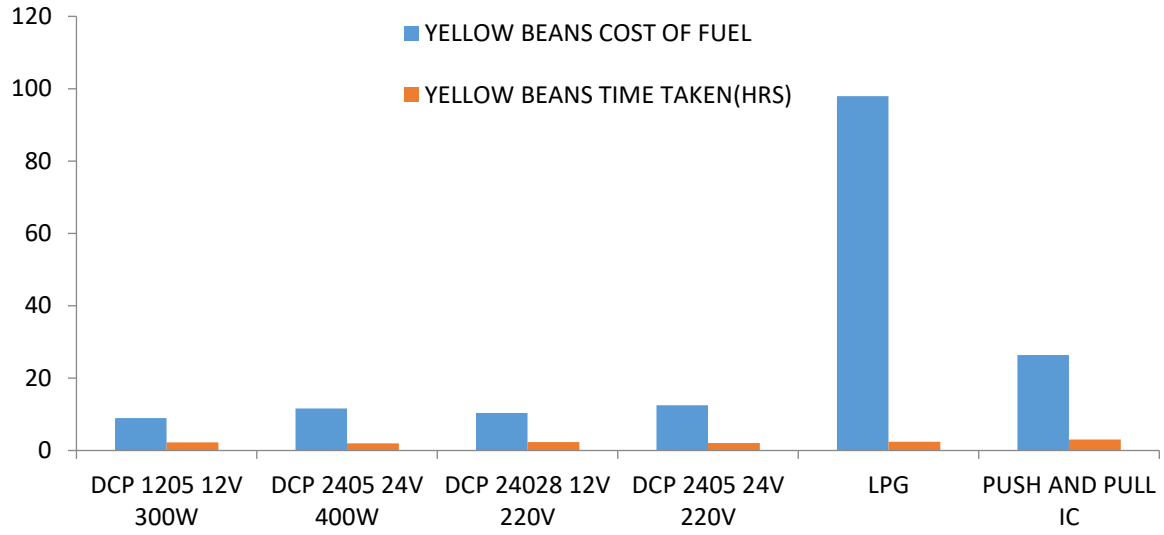

Figure 2.7 Yellow Beans Cost of Fuel and Cooking Time

From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.7 summarizes the sources of variation for samples, columns and interactions within

Table 2.7: ANOVA for Yellow Beans Cost of Fuel and Cooking Time

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	9716.623	5	1943.325	71.39618	1.29E-13	2.620654
Columns	4489.156	1	4489.156	164.928	3.03E-12	4.259677
Interaction	9700.022	5	1940.004	71.2742	1.32E-13	2.620654
Within	653.2533	24	27.21889			
Total	24559.06	35				

Finally, there was rice, common food prepared by the singles and bachelors. 05 kg was cooked using different cooking devices and the cost of fuel & cooking time is indicated in figure 2.8 DCP 1205 12V 300W was the optimum performing in terms of cooking time and power consumed. A unique observation is that LPG and push and pull consumed fuel relatively close to the solar electric pressure cookers.

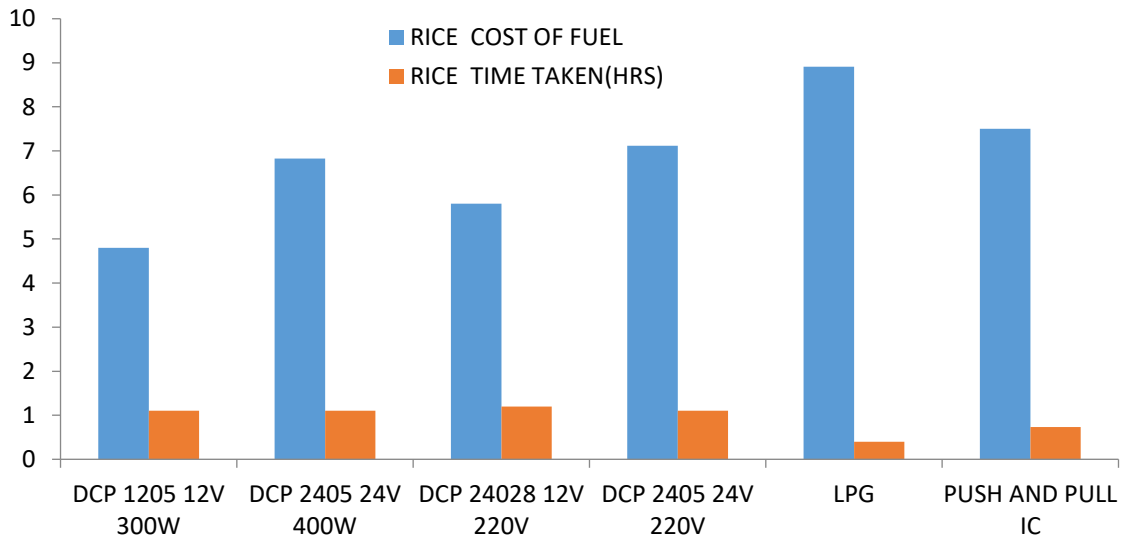

Figure 2.8 Rice Costs of Fuel and Cooking Time

From the analysis of variance, F-value was way greater the F-critical, which implies that there was a significant difference between cooking devices for cooking time and the cost of fuel consumed. Table 2.8 summarizes the sources of variation for samples, columns and interactions within

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	20.97159	5	4.194318	7.824062	0.000173	2.620654
Columns	258.4967	1	258.4967	482.1986	2.13E-17	4.259677
Interaction	35.19807	5	7.039615	13.13167	3.21E-06	2.620654
Within	12.8659	24	0.536079			
Total	327.5323	35				

DCP 1205 12V 300W is the recommended as the best performing for the end user.

KEY CHALLENGES ENCOUNTERED

The following were the key challenges encountered by the participants during Controlled Cooking Test;

i. Burns from the cook stoves
ii. Melting of wire cables from some EPCs
iii. Measuring remaining fuel especially for cook stoves was a problem due to high heat generated even to the environment
iv. Emissions from cook stoves led to a lot of sneezing to the data collectors
v. The EPCs lid sometimes became so hot making it hard to data collectors to handle it
vi. It was time consuming to carry more than three trials
vii. The EPC lacks a timer which could be very helpful in timing cooking time
viii. The warm function is not functional on the EPCs

KEY OBSERVATIONS

The following were the key observations made during the controlled cooking test;

i. Safety precautions should be observed especially when releasing pressure from EPC
ii. EPC are very excellent in boiling foods as compared to other cooking devices and consumes less power
iii. Food cooked from EPC was very sweet and tasty and we noticed there was no loss in its nutritional value
iv. EPC cooks food faster than the other methods we adopted during the tests
v. EPCs are safer and user friendly as compared to cook stoves and LPG since there is no loss of heat to the environment and you can engage to other income generating activities while using it
vi. LPG is less suitable in boiling foods as compared to EPC

vii. LPG is costly to use especially on boiling foods

viii. It takes time to release all pressure from EPC

ix. Food cooked by EPC is clean as compared from that cooked by cook stoves

RECOMMENDATIONS

The following were the key Recommendations agreed upon by all the participants during Controlled Cooking Test which should be considered in future;

i. A timer should be incorporated on the EPC to improve accuracy in cooking time

ii. Using better wire cables to avoid the problem of melting

iii. Batteries with high storage capacity should be used

iv. Proper insulation of the EPC lid to make them more safer

v. Incorporate another DC coil in the EPC element to reduce cooking time

vi. Use batteries with increased life cycle and greater depth of discharge

vii. Make the warm functional

viii. Incorporate a circuit breaker to improve on safety of EPC

ix. Proper training on maintenance and operation of the EPC to the end user

x. To reduce on fuel consumption LPG should not be often used on boiling foods

xi. A gas meter should be incorporated on LPG to meter the fuel consumption

xii. Proper training on end user of LPG

xiii. Use improved cook stoves to reduce fuel consumption especially as opposed to Juakali Jiko