A Comparison of Three Potato Peeler Designs

Åshild Bøe Drejer[1], Truls Enstad[1], Erik R. M. Fog[1], Thor Oskar F. Viken[1], Fausto Orsi Medola[2] and Frode Eika Sandnes[1,3]

[1] Oslo Metropolitan University, 0130 Oslo, Norway
[2] Sao Paulo State University (UNESP), Bauru, Brazil
[3] Kristiania University College, 0153 Oslo, Norway
ashilddrejer@gmail.com, truens@pm.me, erikfog98@hotmail.com, Thor.f.oskar@gmail.com, fausto.medola@unesp.br, frodes@oslomet.no

Abstract. This study set out to compare the effectiveness and efficiency of three common potato peeler designs, and whether there were any differences related to gender in terms of use. An experiment was designed involving a timed potato-peeling task using three different potato peeler designs. A balanced group of $N = 20$ males and females was recruited. The results showed that the vertical peeler with flexible blade resulted in the shortest peeling times. This peeler also produced least waste although these differences were not statistically significant. The results did not reveal any statistically significant gender differences.

Keywords: Kitchen utensil ergonomics · Utensil design · Potato peelers.

1 Introduction

Potatoes are an important staple for carbohydrates. Although modern life means that individuals increasingly resort to preprocessed food, there are still situations where food is cooked from first principles using the appropriate tools and utensils. There is to the best of our knowledge no previous empirical studies of potato peeler performance. We wanted to investigate if there are measurable differences between different potato peeler designs and any gender related differences in terms of use. We therefore designed a small controlled experiment involving a potato peeling task to compare three commonly available potato peeler designs in terms of peeling speed and amount of waste produced.

2 Related work

There are seemingly few academic works on potato peelers, although there are several patents issued during the last 70 years that document various designs [1, 2, 3, 4, 5]. Some of the academic works are in the domain of agriculture [6, 7] and food production including potato peeling [8] chips making [9].

Within the field of product design kitchen utensils is an active area of research [10, 11]. Key issues include work related injuries caused by certain designs [12] and uni-

This is a post-peer-review, pre-copyedit version of a conference proceeding published in IHSED 2020: Human Systems Engineering and Design III, Proceedings of the 3rd International Conference on Human Systems Engineering and Design (IHSED2020): Future Trends and Applications, which is part of the Advances in Intelligent Systems and Computing book series (volume 1269). The final authenticated version is available online at: http://dx.doi.org/10.1007/978-3-030-58282-1_56

versal [13] utensil design for the aging population [14]. Kitchen utensils are also an issue in the domain of health and safety [15]. An overview of the evolvement of the domestic kitchen can be found in [16].

3 Method

3.1 Experimental design

A mixed controlled experiment was designed comprising one within-group independent variable potato peeler with the levels y-peeler, vertical peeler with flexible blade and vertical peeler with fixed blade. Gender was the between-groups independent variable with the levels male and female. Two dependent variables were measured, namely the task completion time, i.e., the time it took to peel each potato, and the amount of peel resulting from each peeling task. The amount of peel is considered a measure of accuracy as removing as little as possible of the non-peel part of the potato is considered more accurate than removing a larger portion of the non-peel part.

3.2 Participants

A total of 20 participants were recruited, comprising 10 males and 10 females. All the participants were recruited at the main campus of the authors' university. Most of the participants were in their early 20s.

3.3 Task

The task comprised peeling potatoes using the three potato peelers.

3.4 Materials

The potatoes used in the experiment was first manually screened to ensure that they were as similar as practically possible both in terms of shape and mass. In total, 60 potatoes were used in the experiment with a mass of (M = 116.0 g, SD = 18.2). The smallest potato had a mass of 80.0 g and the largest 173.0 g.

3.5 Equipment

Fig. 1 shows the three common potato peeler designs that were used in the experiment. The y-peeler has a flexible horizontal blade. Typically, the users will move the y-peeler towards themselves to peel. There were two vertical peelers, one with a flexible blade that moves with the contour of the potato and one with a fixed blade that does not move. All the peelers were made in metal, but the vertical peeler with a fixed blade had a hard-plastic handle.

Fig. 1. The three potato peelers used, namely the y-peeler with flexible blade (left), vertical with flexible blade (middle) and vertical with fixed blade (right).

3.6 Procedure

Each participant was first informed about the experiment and then asked to peel three potatoes using the three potato peelers at a comfortable pace in which they were used to. We wanted the experiment to come across as a realistic potato peeling session and not as a competition. The presentation order of the three potato peelers was randomized to minimize any potential bias. For each potato, the total peeling time was measured using a stopwatch. The mass of each potato was also measured before and after peeling process to determine the amount of peel produced in the process. The scales used had a resolution of 1 g.

All the measurements were collected in one session for each participant and participation was voluntary. Participants were therefore anonymous. The data were analyzed using JASP.

4 Results

Fig. 2 shows the results of the task completion time measurements. The results show a significant effect on the type of peeler used ($F(2, 36) = 10.974$, $p < .001$), in that the vertical peeler with fixed blade is the slowest ($M = 41.9$, $SD = 28.9$) while Y-peeler ($M = 40.8$, $SD = 21.6$) and the vertical peeler with flexible blade ($M = 38.8$, $SD = 22.7$) yield similar results although the vertical flexible peeler yields the fastest peeling times. Post-hoc tests confirm that the vertical peeler with fixed blade was significantly slower than both the y-peeler ($p < .001$) and the vertical peeler with flexible blade ($p < .001$). There was no significant difference in task completion time between the y-peeler and the vertical peeler with flexible blade.

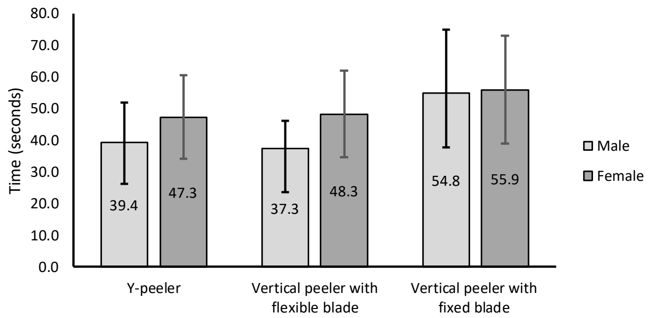

Fig. 2. Task completion times in seconds. Error bars show standard deviation.

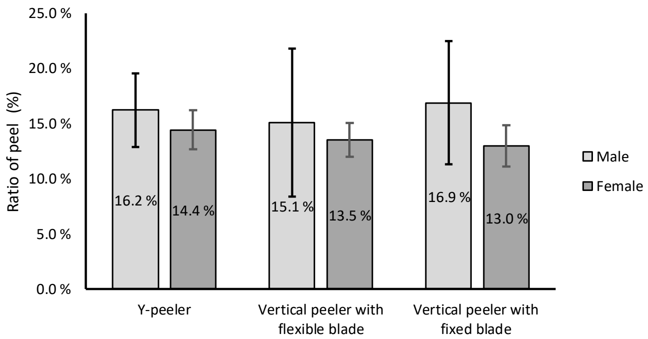

Fig. 3. Accuracy (ratio of peel to potato mass in percentages). Error bars show standard deviation.

There was no significant effect of gender ($F(1, 18) = 0.860$, $p = 0.366$). The results appear to be quite similar for both males and females with the vertical fixed blade peeler. However, although not significant, males seemed to use the two fastest peelers approximately 10 seconds (or 20%) faster than females. That is, males with y-peeler ($M = 39.4$, $SD = 12.6$) versus females with y-peeler ($M = 47.3$, $SD = 13.6$), and males with vertical flexible peeler ($M = 37.3$, $SD = 8.8$) versus females with vertical flexible peeler ($M = 48.3$, $SD = 13.8$).

Fig. 3 shows the results of the mass reduction measurements. No significant effects of either peeler type ($F(2, 36) = 0.739$, $p = .485$) or gender ($F(1, 18) = 1.230$, $p = .282$) could be observed. However, an inspection of the results shows that the females generally produce less peel than the males with all the peelers. Interestingly, females produce the most peel with the y-peeler ($M = 14.4\%$, $5 = 1.8$) and least with the vertical peeler with fixed blade ($M = 13.0\%$, $SD = 1.9$), while males produce the most peel with the vertical peeler with the fixed blade ($M = 16.9\%$, $SD = 5.6$) and least peel with the vertical peeler with the flexible blade ($M = 15.1\%$, $SD = 6.7$). The spread in peel is also much larger for males compared to females. Looking at the results it seems the least peel is achieved with the two vertical peelers. Overall, the spread is much larger with the vertical peeler with fixed blade and the results indicate that the vertical peeler with flexible blade yields more consistent results across all the participants.

Although steps were taken to minimize the variation in potato mass, small variations were unavoidable. To check that the amount of peel is related to the mass of the potato, the reduction in mass after each potato was peeled was correlated with the original mass before peeling. The mass of the peel correlated strongly and significantly with the mass of the potatoes ($r(60) = 0.544$, $p < .001$), 95% CI [0.337, 0.701].

5 Discussion

The results show that potato peelers with flexible blade are faster than the peeler with a fixed blade. One explanation for this could be that the user simply has focus on the side to side motion while peeling and not having to also focus on a turning motion to make the blade follow the contour of the potatoes. The flexible blade follows the shape of the potato. Hence, the user needs to make less complicated maneuvers. There we no significant differences between the two flexible-blade peelers, but the vertical peeler appears slightly faster and results in slightly less peel. In addition to the handle orientation in relation to the blade, there is also a difference in the handgrip diameter. The relation between handle diameter and orientation and force transmission was explored in the study of Kong and Lowe [17]. While big handles are more beneficial when the task involve the application of higher levels of force, smaller handle diameters – which is the case of the two vertical peelers – allow variation and fine adjustments of the objects' position in the hand thus facilitating more accurate movements. The two vertical peelers provided more accuracy than the y-peeler among the females, while only the vertical with flexible blade was more accurate than the y-peeler for the men.

The results did not reveal any significant gender differences. However, the results indicate that some males completed the peeling task faster than females. We did indeed observe that some of the male participants rushed the task, possibly due to have somewhat treated the task as a contest. A possible consequence of rushing the task may have been that some males produced more peel. In fact, using a knife a potato can be quickly peeled with six cuts of a knife if the potato is cut into a cube-like shape. This would clearly be classified as a peeled potato, but also much waste.

The results show that there are large variations in the data. The 20 participants recruited are on the low side. It would have been interesting to have repeated the experiment with more participants in each group. Moreover, we got the impression that most of the participants were already somewhat familiar with the potato peeler designs, but we did not systematically ask the participants about previous experience and familiarity with the peelers. It would probably have been useful to include details about such previous experience and familiarity in the analysis.

6 Conclusions

An experiment was designed to compare three potato peeler designs and to uncover any gender differences related to use. The results showed that the vertical peeler with flexible blade was the fastest. The vertical peeler with the flexible blade also produced least waste although these differences were not statistically significant. The results did not show any significant gender related differences. The results are based on the observation of a small and limited cohort comprising relatively young individuals. It would be interesting to have extended the study with different age groups.

References

1. Dolan, C.H.: U.S. Patent No. 2,407,819. Washington, DC: U.S. Patent and Trademark Office (1946).
2. Fender, F.E.: U.S. Patent No. 2,232,940. Washington, DC: U.S. Patent and Trademark Office (1941).
3. Ness, R.: U.S. Patent No. 3,956,825. Washington, DC: U.S. Patent and Trademark Office (1976).
4. Wang, P.: U.S. Patent No. 6,854,383. Washington, DC: U.S. Patent and Trademark Office. (2005).
5. Young, E.C.: U.S. Patent No. 2,958,355. Washington, DC: U.S. Patent and Trademark Office (1960).
6. Pérombelon, M.C.M., Lumb, V M., Hyman, L.J.: A rapid method to identify and quantify soft rot erwinias on seed potato tubers 1. EPPO Bulletin **17**(1), 25-35 (1987).
7. Misener, G.C., Mcleod, C.D., McMillan, L.P.: Evaluation of a prototype potato harvester. Transactions of the ASAE **27**(1), 24-0028 (1984).
8. Chand, K., Pandey, R.K., Shahi, N.C., Lohani, U.C.: Pedal operated integrated potato peeler and slicer. Agricultural mechanization in Asia, Africa & Latin America **44**(1), 65-68 (2013).
9. Pradhan, A.K., Dandale, A., Banpurkar, R.: Review Paper on Semi Automatic Chips Machine. International Research Journal of Engineering and Technology **4**(03), (2017).
10. Branowski, B., Rychlik, M., Sydor, M., Zabłocki, M.: Graphic 3D ergonomic database in evaluation of virtual models of kitchen design/adaptation for needs of handicapped persons, Computer-aided design systems. Theory and Practice, Lviv Polytechnic National University 711, 112-121. (2011).
11. Suhas, M., Prajapathi, P., Jolhe, D.A., Lakhe, R R.: A study of Indian kitchen from ergonomic consideration. Industrial engineering journal **12,** 1-19 (2019).
12. Subramaniam, S., Murugen, S.: Investigation of work-related musculoskeletal disorders among male kitchen workers in South India. International Journal of Occupational Safety and Ergonomics **21**(4), 524-531 (2015).
13. Sandnes, F. E.: Universell utforming av IKT-systemer, Oslo: Universitetsforlaget, 2nd edition (2018).
14. Maguire, M., Peace, S., Nicolle, C., Marshall, R., Sims, R., Percival, J., Lawton, C.: Kitchen living in later life: Exploring ergonomic problems, coping strategies and design solutions. International journal of design **8**(1), 73-91 (2014).
15. Mondal, J.: A Review on Mechanical & Physical Hazards at Domestic Kitchen. International Journal of Occupational Safety and Health **2**(1), 7-10 (2012).
16. Charytonowicz, J., Latala, D.: Evolution of domestic kitchen. In: International Conference on Universal Access in Human-Computer Interaction, pp. 348-357. Springer, Berlin, Heidelberg. (2011).
17. Kong, Y-K., Lowe, B.D.: Evaluation of handle diameters and orientations in a maximum torque task. International Journal of Industrial Ergonomics **35**(12), 1073-1084 (2005).