Automatic Solvent Extraction of Polyphenols from Peach Peels (Prunus Persica) and Investigation Storage Stability

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Introduction

Rosaceae family is the 19th largest plant family. The Rosaceae family includes some common genera such as Prunus (peach), Pirus (apple). It is a large family consisting of approximately 90-125 genera and 3370-3500 tree, bush and grass species (Kant et al., 2018) Peach (Prunus Persica), which is from the Rosaceae family, is an extremely popular fruit worldwide with an annual production of close to 20 million tons. Peach (Prunus persica L.) is among the economical and nutritious fruits. Carbohydrates, organic acids, minerals and fibers, which are among the main components of peach fruit, contribute to the nutritional quality of both fresh fruits and fruit juices. Peaches are extremely rich in vitamin A and potassium, as well as having significant amounts of other valuable ingredients such as organic acids and natural sugars. These ingredients increase the nutritional power of peach (Manzoor et al., 2012). In addition, peaches are rich in antioxidants, an important source of phenolic compounds such as vitamins A, B and C, carotenoids and chlorogenic and neochlorogenic acids, catechin, epicatechin, cyanidine and quercetin derivatives (Zheng et al., 2014).

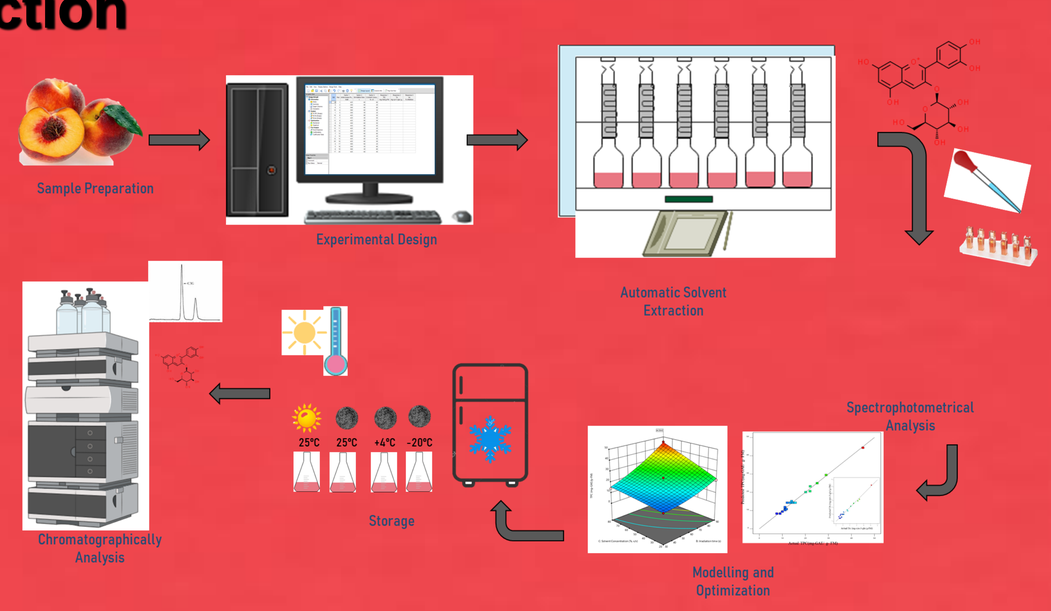

Figure 1: Graphical abstract of experimental study.

In the scope of this study, peach peels wastes have been evaluated. The extraction of these wastes has been studied by advanced and environmentally friendly separation method automatic solvent extraction (ASE). On the other hand, the operating conditions will be statistically optimized using the response surface method (RSM) and in this way the most efficient process will be determined. The interactions between the applied methods and natural products and the optimum conditions for extraction have been determined by analyzing the obtained samples by spectrophotometric and chromatographic methods. The stability of the recycled natural products has been examined as a result of preserving their biological activity under different conditions (temperature and light). The study has suggested that 25.4 min of immersion time, 48.5 min of washing time, 0.118 g solid mass and 75 % solvent concentration as optimum conditions to obtain TPC (117.32 mg-GAE/g-FM) and TA (7.10 mg-cyanidin-3- glucoside/g- FM) peach peel.

Results & Discussion

Table 1: Experimental results for the TPC and TA extraction depending on face centeral composite design for process parameters*

Experiment No	Immersion time (min)	Washing time (min)	Solid mass (g)	Solvent Concentration (%, v/v)	TPC (mg-GAE/ g-FM)	TA (mg-cyn-3-glu/ g-FM)
1	20	50	0.3	20	41.35±0.001^{a**}	3.45±0.001^{a}
2	20	50	0.3	50	47.83±0.002^{b}	2.65±0.002^{b}
3	10	60	0.5	20	28.85±0.001^{c}	1.21±0.001^{c}
4	20	40	0.3	50	31.26±0.003^{d}	0.86±0.001^{d}
5	20	50	0.3	50	49.42±0.001^{e}	2.82±0.002^{e}
6	20	50	0.3	50	48.46±0.002^{f}	2.78±0.001^{f}
7	30	60	0.5	20	20.08±0.001^{g}	0.47±0.002^{g}
8	10	40	0.1	80	100.13±0.000^{g}	6.32±0.001^{h}
9	30	40	0.1	20	67.12±0.001^{h}	1.81±0.003^{i}
10	10	40	0.5	20	32.62±0.001^{i}	1.73±0.000^{i}
11	20	50	0.3	50	41.25±0.002^{i}	2.67±0.001^{j}
12	10	60	0.1	20	64.78±0.003^{j}	4.70±0.001^{k}
13	30	40	0.1	80	107.12±0.001^{k}	4.70±0.002^{k}
14	10	60	0.5	80	31.43±0.002^{l}	1.12±0.001^{l}
15	20	50	0.3	50	45.42±0.004^{m}	2.32±0.001^{m}
16	10	50	0.3	50	45.13±0.003^{n}	2.13±0.004^{n}
17	20	50	0.1	50	102.36±0.001^{o}	6.52±0.001^{o}
18	20	50	0.5	50	48.12±0.002^{p}	2.91±0.002^{p}
19	30	50	0.3	50	49.53±0.001^{r}	1.12±0.001^{l}
20	30	40	0.5	20	17.10±0.002^{s}	0.24±0.001^{r}
21	30	60	0.5	80	8.24±0.001^{t}	0.46±0.003^{s}
22	20	50	0.3	80	66.33±0.004^{t}	5.05±0.001^{t}
23	10	60	0.1	80	114.94±0.001^{u}	7.45±0.001^{u}
24	10	40	0.1	20	57.15±0.003^{u}	4.40±0.002^{v}
25	30	60	0.1	80	102.24±0.002^{v}	5.99±0.004^{y}
26	20	50	0.3	50	43.21±0.001^{y}	2.60±0.001^{z}
27	20	60	0.3	50	33.65±0.001^{z}	0.97±0.003^{q}
28	30	40	0.5	80	16.19±0.002^{q}	0.36±0.001^{w}
29	10	40	0.5	80	43.90±0.001^{w}	2.56±0.002^{s}
30	30	60	0.1	20	76.12±0.001^{x}	3.92±0.001^{c}

*Data are given as the mean (n=3) ± standard deviation
**Each value is the mean ± standard deviation of three replicate analyses. Means within the same column not sharing a common letter indicate significant difference at p<0.001.

Depending on the conditions applied to obtain bioactive rich extract from peach peels by ASE method, the total amount of phenolic content varies between 8.24 and 114.94 mg-GAE per gram of frech material (Table 1).The total amounts of peach peel extracts obtained with ASE range from 0.36 to 7.45 mg-cyn-3-glu/ g-FM.

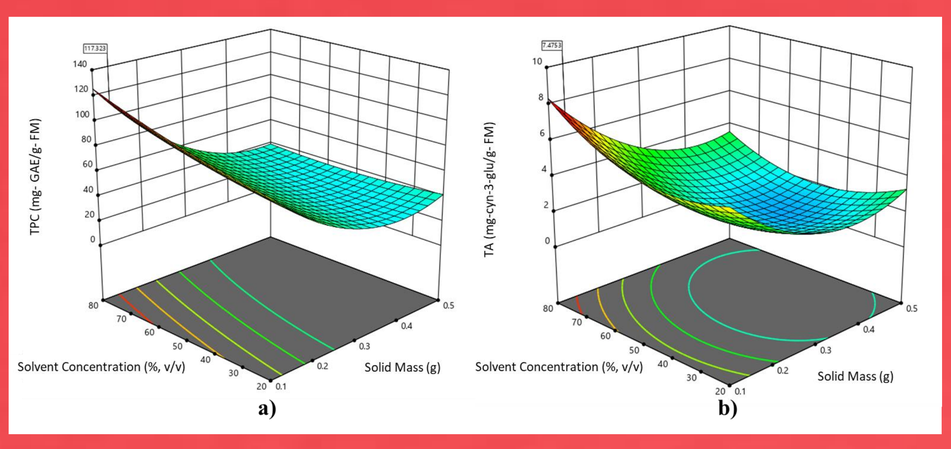

Figure 2: The 3D surface plot for the (**a**) TPC, (**b**) TA of the peach peels extract as a function of solvent concentration to solid mass (Washing time=49.51 min and immersion time =17.07 min).

According to the ANOVA test results calculated for TFM and TA extraction from peach peels, the most effective parameters were found to be solvent concentration and solid matter content. Figure 2 shows the effects of solvent concentration and solid mass on total phenolic content (a) and total anthocyanin (b) at some fixed values (immersion time=25.4 min, wash time=48.5 min). Similar trends are observed for both systems. The amount of TPC and TA in the obtained peach peel extract increased proportionally as the alcohol content in the solvent system increased. There is an inversely proportional extract yield with the amount of peel.

Optimization study was carried out with Desing-Expert software to obtain a maximum extract in terms of TPC and TA of peach peels using automatic solvent extraction. According to the optimization study of the FCC design with the Desing-Expert software, to obtain the highest TPC (117.32mg-GAE/ g-FM) and TA (7.47 mg-cyn-3-glu/ g-FM) yields. The acceptable residual between the experimental and calculated results also supports that the model is suitable for these systems.

For all quality parameters (in terms of phenolic and anthocyanin contents), the most degradation was observed in samples kept under light at room temperature (Figure 3). It is remarkable that the difference between the degradation rates of the peach peel extracts obtained by using the automatic solvent extraction method, especially in dark and bright environments, is not high.

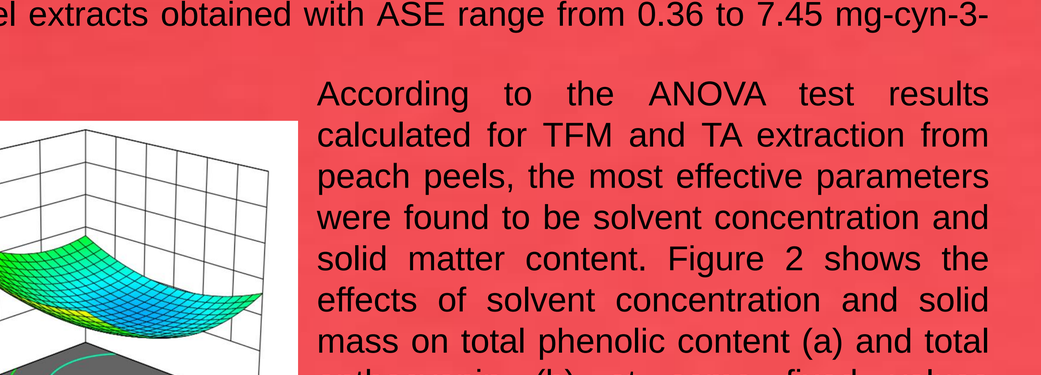

Figure 3:Storage stability of peach peel extracts prepared by ASE at different storage conditions depending on TPC (**a**), TA (**b**)

Conclusions

The present study has investigated the optimized automatic solvent extraction process and storage conditions for peach peel extracts. The study has suggested that 25.4min of immersion time, 48.5 min of washing time, 0.11 g solid mass and 75 % solvent concentration as optimum conditions to obtain TPC (119.74 mg-GAE/g-FM) and TA (8.85 mg-cyanidin-3-glucoside/g- FM) from peach peel.

References

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