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Research Article

DEVELOPMENT OF QUINOA (*CHENOPODIUM QUINOA*) SUPPLEMENTED COOKIES

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ABSTRACT

Quinoa (*Chenopodium quinoa*) a pseudo cereal belongs to family "Chenopodiaceae" containing a good quantity of essential micronutrients especially calcium, phosphorus, iron, zinc etc. along with basic nutrients. Quinoa seeds are not true grains and not considered as fruit so they are considered as pseudo-cereal as well as pseudo oil seeds. The reason behind the calling pseudo oil seed is that quinoa has well and balance quantity and quality of fats and proteins. The present study was designed to develop quinoa supplemented cookies by using quinoa flour to overcome the threat of malnutrition. For this, quinoa flour was produced through milling process and analyzed for nutritional profile. Afterwards quinoa supplemented cookies were developed by using 0%, 10%, 20%, 30%, 40% and 50% quinoa flour. Then physico-chemical as well as organoleptic properties of these quinoa supplemented cookies were assessed. Physicochemical results indicated that spread factor ratio and moisture were ranged from 10.74-9.51 and 2.5-3%, respectively due to variation in concentration on quinoa. Similarly, protein and fat contents were significantly increased with elevation in concentration of quinoa. Organoleptic evaluation indicated that quinoa supplementation up to 20% was acceptable by the consumer.

Keywords: Quinoa, Cookies, Supplementation, Nutrition

1. INTRODUCTION

Quinoa (*Chenopodium quinoa)* is also considered as pseudo-cereal as well as pseudo oil seeds crop which belongs to family "Chenopodiaceae" (Jancurova *et al*., 2009; Vega-Galvez *et al*., 2010). Quinoa has been cultivated from many years in Andean regions (Caperuto *et al*., 2001). Quinoa is a dicot plant with the height of 1-3m from the soil and normally grown in every type of soil because it has long root system almost 30cm. This plant has the ability to produce grain even if it is sow at the high up to 4500 meter and along carrying higher nutritive value than other cereals crop (Tapia, 1997). Quinoa usually has cylindrical stem with diameter 3.5cm and varies in color from variety to variety. Its leaves are similar to goose foot. The shape of quinoa seeds is round and flat and its diameter is about 1.5-4.0 mm and the weight of the seed is 1 g per 350 seeds (Ruales and Nair, 1993). The color of the seeds is varied from white to grey and black (Mujica 1994).

There are almost 250 varieties of quinoa worldwide which are classified on the basis of plant morphology, phenology, and physical appearance and somehow due to the tissues chemical composition (Gordillo-Bastidas *et al*., 2016). Nowadays quinoa is classified on the base of morphological properties but during early period of classification quinoa was classified on the base of color. For getting good benefits and good yield of quinoa it must be cultivated in the rotation of potatoes because soil fertility increases which is very beneficial in good yield and as the microorganisms are effective in the good growth and yield of crops.

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It is sown in August to September and reach at the level of maturity during the mid of June. The yield of quinoa was 23200 tons in the year 2000 which became double in just 12 years and it became 44200 tons in 2012 worldwide (INE, 2013). Just like Bolivia in many other Andean region countries like Peru, Argentina, Chile etc gradually became the big exporter of quinoa till 2013. But the two countries Peru and Bolivia alone produce more than 90 percent quinoa from all around the world (Baudoin and Avitabile, 2013). Quinoa is a complete food with high nutritional value due mainly to its high content of good quality protein. In 1996, quinoa was catalogued by FAO as one of the most promising crops for the humanity, not only for its great properties and multiple uses, but it is also considered an option to solve human nutrition problems (FAO, 2013).

There is no any other plant source food which has all essential amino acids as per the nutrition requirement of human body given by the Food and Agriculture Organization (FAO) of the United Nations Organization (UNO) (Koziol 1992; González *et al*., 2012). Along with the high nutritional value it is very cheap to grow because it has the ability to grow under different environmental and climatic conditions as well as it also has broad genetic variability (Fundacion-PROINPA, 2011). Due to all these features and many other uses demand of the quinoa is rapidly increasing all around the world and it is becoming the ruling crop as well as food to be used in different regions of the world which includes different countries of Asia, Africa, Europe and specially in north America all these regions adopted and started to grow this crop (Jacobsen, 2003). Presence of methionine and lysine which are leading reasons of quinoa attraction as food source as compared to the vegetables and its composition of amino acid. Quinoa contains protein contents 13.7%, lipids 15.5%, ash contents 3.5%, carbohydrates 65.7% and fiber 2.6% (Dini *et al*., 1992). Wright with his co-workers also observed that it contains protein 16.7%, lipids 5.5%, ash 3.2%, carbohydrates 74.7%, and fiber 10.5% (Wright *et al*., 2002). Saponins, phytosterols and phytoecdysteroids are the prominent phytochemicals in quinoa (Graf *et al*., 2015). On the other hand, the presence of saponins in quinoa prove helpful in different biological effects i.e. anticancer, antiviral, antifungal, hypocholesterolemia, anti-inflammatory, diuretic, hypoglycemic and antithrombotic activities (Vega-Galvez *et al*., 2010). Quinoa grains contain about 118mg/100g of phytosterols and prominent phytosterols are b-sitsterol, campsterol, stigmasterol, and brassicasterol (Villacres *et al*., 2013). Phytoecdysteroids are the important phytochemicals among all other phytochemicals and quinoa consist on highest level of phytoecdysteroids as compared to all other plant sources. The quantity of phytoecdysteroids in quinoa grain ranges from 138 to 570µg/g (Dinan, 2009). The quinoa grain consists on 13 different types of phytoesdysteroids and 20-hydroxyecdysone (20HE) is the most abundant phytoecdysteroiods about 62% to 90% (Graf *et al*., 2015).

The consumption of quinoa seeds is very old and it is traditionally used in South America (Vega-Galvez at el., 2010). The use of quinoa seed is just like other cereals such as rice, it is used in soup preparation. It is also used as breakfast cereal by making puffed food items as well as it is also converted into flour and used to prepare some bakery food products such as cookies, biscuits, breads, noodles and cakes (Bhargava *et al*., 2006). Besides from seeds other part of quinoa crop can also be used such as leaves of quinoa crop which can be eaten just like spinach (Oelke at al., 1992) and some germinated seeds of quinoa crop are used in salads (Schlick and Bubenheim 1996). Additionally, the seeds of quinoa are fermented to make beer, alcoholic drinks and a beverage in Andean region with name of "chicha" (Healy 2001; FAO 2011).

Quinoa grains have goods attributes related to health factor and it can be used as a cure against many diseases in all groups of consumers. Different peoples may suffer from different diseases such osteoporosis in women, anemia, obesity and celiac

diseases. The quinoa grains are the good source of nutrients (amino acids, minerals, vitamins, fibers, unsaturated fats, phytochemicals and antioxidants) that could prevent or reduce the risk of these diseases because of its high nutritional profile, good therapeutic features and gluten free cereal (Zevallos *et al*., 2014).

2. OBJECTIVE

Determination of physio-chemical properties of Quinoa flour.

Development of Quinoa supplemented cookies and

Assessment of quality and consumer acceptability of micronutrient enriched cookies through organoleptic evaluation

3. MATERIAL AND METHODS

3.1. Procurement of material

Quinoa grains were obtained from the Agronomy Department, MNS-University of Agriculture Multan. After procurement the raw material was stored at room temperature for the purpose of milling for two days.

3.2. Flour preparation

After procurement, quinoa grains were removed from store room and soaked in clean water for the purpose of removal of debris from seed. After soaking, quinoa seed was dried in hot air oven at 60ºC for 3-4 h before milling to convert it into quinoa flour. The flour was sieved through 60 BSS pour size to obtain uniform quality of flour.

4. PROXIMATE STUDY OF QUINOA FLOUR

4.1. Moisture analysis

Moisture content of quinoa flour was determined in hot air oven according to the procedure followed by AACC (2000). Five grams sample of quinoa flour was weighed in already weighed dish and the put into the drying oven at 105^0C for 24 hours. After drying, sample was again weighed and note the final reading which is a percentage of actual moisture calculated by using the equation shown below.

$$\text{Moisture } \% = \frac{\text{weight of actual sample} - \text{weight of dried sample}}{\text{weight of actual sample}} \times 100$$

4.2. Ash

Ash percentage of quinoa flour was evaluated by the process as defined in AACC (2000). Weigh 10 g sample of quinoa flour in crucible and then put into the muffle furnace at 550^0C for 5 h. After 5 h the flour was converted into grayish white residue. The percentage of ash was estimated by the equation given below. The percentage of ash was estimated by the equation given below.

$$\text{Ash } \% = \frac{\text{weight of grayish residues}}{\text{weight of actual sample}} \times 100$$

4.3. Crude fat

The crude fiber of quinoa flour was evaluated by applying soxhlet apparatus procedure as defined in AACC (2000). A sample to quinoa powder was taken up to 5g in extraction thimble and thimble was kept in soxhlet apparatus by using for 2-3 h, petroleum ether. The conical flask was used which contained a solvent by keeping it on the heater to seized the vapor at the tube of the apparatus and these vapors was concentrated at upper part of the tube just because of the circulation of chilled water. Then a thimble was taken which consisted on a sample and these drops after condensation was dipped in that thimble. The flask which was heated previously, dissembled, dried, reduce the temperature and then weighed the receiving flask which was contained the fat then this flask was dried through hot air oven, cooled in a desiccator and then weigh it. After that by means of the formula given below crude fat % was estimated.

$$\text{Fat } \% = \frac{\text{weight of actual sample} - \text{fat free sample}}{\text{weight of actual sample}} \times 100$$

4.4. Crude fiber

Crude fiber of quinoa flour was determined through adopting the procedure of AACC (2000). Weigh 10g fat free sample of flour was taken and then digested in 200 ml 1.25% H_2SO_4. After digestion filtration was done, the sample was washed with ethanol three times. After washing with ethanol again digestion was done for 30 minutes with boiling NaOH with volume upto 200 ml and again filtration of the sample was done then washing of the sample was also done thrice with ethanol. After that sample was ignite at 600 C for 2-4h and then crude fiber was calculated by following equation.

$$\text{Fiber } \% = \frac{\text{weight loss on ignition}}{\text{weight of actual sample}} \times 100$$

4.5. Crude protein

The crude contents of protein was analyzed in quinoa flour, by utilization of Kjeldhal process as illustrated in AACC (2000). The 2g sample of quinoa flour was taken in digestion tube with2 tablets of catalyst as digestion mixture (as catalyst) and 98% concentrated sulphuric acid (H_2SO_4) upto 20 ml. After 3 to 4 hours of the digestion process, the transparent residues were obtained. Then for neutralize the mixture add 40% NaOH solution up to 70ml and also release the ammonia gas. The distillation of the neutralize solution was done by the means of Kjeldahl's distillation process. The released NH_4 gas was confined in 4%solution of boric acid which contained indicators.

$$\text{Nitrogen } \% = \frac{0.1\text{N vol.of } H_2SO4 \times \text{vol.of dilution prepared} \times 0.0014}{\text{weight of actual sample} \times \text{vol.of dilution taken}} \times 100$$

4.6. Nitrogen free extracts (NFE)

The NFE of quinoa flour was determined by the formula below

$$\text{NFE } \% = 100 - (\text{Moisture } \% + \text{fat } \% + \text{fiber } \% + \text{protein } \% + \text{ash}\%)$$

4.7. Total phenolic contents (TPC)

For the estimation of total phenolic contents, folin-ciocalteu reagent was used for adopting the procedure as described by AOAC (2000). According the procedure 0.50 ml diluted sample was reacted with 2.5 mL mol/L Folin-Ciocalteu for about 4 min and then added the saturated sodium carbonate upto 2mL in the mixture. Then incubation of the mixture was done at room temperature for 2 hours and the reading of absorbance was noted almost 760 nm. Then the results were estimated in milligram gallic acid equivalent (mg GAE)/g dry weight of sample because the gallic acid was used as a reference standard.

4.8. Development of quinoa supplemented cookies

For the development of quinoa supplemented cookies, the ingredients according to the treatment plan were weighed and mixed by using water to make dough. Five different treatments on the basis of quinoa flour concentration (10%, 20%, 30%, 40% and 50%) along with control (0%) was prepared. The baking of cookies was done at 450ºF (230ºC) for 12 to 15 minutes AACC (2000).

4.9. Compositional analysis of cookies

The physio-chemical composition (protein, crude fat, fiber, total mineral contents and moisture contents), total phenolic contents, minerals of cookies were analyzed by the methods described earlier.

4.10. Sensory Analysis

Suitability and consumer acceptability of cookies were determined by using 9 point Hedonic Rating Scale with sensory parameters (Aroma, taste, body and texture, crispiness, mouth feel, volume, graininess and overall acceptability) through a panel of assessors (Meilgaard *et al*., 2007).

5. RESULT AND DISCUSSION

5.1. Proximate composition

5.1.1. Proximate evaluation of Quinoa flour

The composition of quinoa flour was examined and result showed that, there was moisture 9.5±1%, crude fat 5.13±0.44, protein 14.33±0.25, dietry fiber 13.33±0.52 crude ash 2.77±0.021% and total phenolic contents are 1203.62±7.21%. Compositional analysis showed that, quinoa flour is enriched cereal product (Table 1)**.**

5.1.2. Physiochemical Analysis

Moisture

The statistical consequences regarding moisture percentage of quinoa powder supplemented cookies indicated that the result of treatments (levels of quinoa powder supplementation) and effect of storage duration on moisture percentage of cookies were revealed to be significantly high. Whereas, the combine impact of treatments (levels of quinoa supplementation) and storage time on moisture percentage of the product were exposed to be non-significant. The moisture contents were ranged from 2.66±0.01% to 2.81±0.05% due to variation in treatments as well as storage periods. The highest moisture contents (2.81) were observed in cookies supplemented with T_4 whereas the lowest moisture contents (2.66) were observed in T_5 .The increase in moisture contents during storage might be

due to absorption of moisture from the environment (Table 2).

5.1.3. Protein

The results regarding protein percentage of quinoa powder supplemented cookies were analyzed statistically which demonstrated that the results of treatments (levels of quinoa powder supplementation) and storage time on moisture percentage of cookies were exposed to be significantly high. The outcome of treatments on protein percentage of quinoa supplemented cookies revealed that significantly the highest value protein (9.06%) was achieved by T_5 (cookies with 50% quinoa flour supplementation) whereas lowest protein contents (7.17%) was given to T_0 (cookies prepared by 100% wheat flour).

The protein contents in cookies was increased might be due the fortification with quinoa flour, because this cereal contain high amount of protein contents. The results can also be justified with the finding of Rahman *et al*. (2012) who reported similar results. He concluded that protein degraded with the increase of storage period and condition. Proteins contents was decreased with the increase of storage period that might be due to deterioration of proteins (Table 2).

5.1.4. Fat

The consequence of treatments on fat percentage of quinoa supplemented cookies revealed that significantly the highest fat contents (20.98%) were gained by T_5 (cookies with 50% quinoa flour supplementation) followed by the fat content inT_4 (cookies prepared by supplementation of 40% quinoa flour). However, significantly the lowest fat contents were given to T_1 (cookies with-10% quinoa flour supplementation) with average value of 18.20% (Table 2).

5.1.5. Fiber

The outcome of treatments on fiber percentage of quinoa supplemented cookies demonstrated that fiber contents were given to T_5 (cookies with 50% quinoa flour supplementation) was significantly high with average values of 3.94±0.03% correspondingly. Although, significantly the lowest fiber contents were given to T_0 (cookies with-out quinoa flour supplementation) with mean value of 1.44±0.03% as shown in (Table 2).

5.1.6. NFE

The outcome of treatments on NFE percentage of quinoa supplemented cookies revealed that significantly the high value NFE percentage was given to T_0 (cookies without quinoa flour supplementation) with mean value of 60.46±0.04% correspondingly. Although, significantly the lowest value of NFE contents was given to T_5 (cookies 50% quinoa flour supplementation) with mean value of 59.88±0.06 % as express in (Table 2).

5.1.7. TPC

The outcome of treatments on TPC of quinoa supplemented cookies revealed that significantly the high value TPC was given to T_0 (cookies without quinoa flour supplementation) with mean value of 1283.92±3.14 %correspondingly. Although, significantly the lowest value of TPC was given to T_5 (cookies 50% quinoa flour supplementation) with mean value of 716.87±5.89% as express in (Table 2).

5.2. Sensory evaluation of cookies

5.2.1. Color

The influence of treatments on color of quinoa supplemented cookies demonstrated that the highest color score was given to T_0 (cookies without quinoa flour supplementation) significantly high with mean score of 8.28±0.07 correspondingly. The T_5 (cookies prepared by supplementation of 50% quinoa flour) significantly showed lowest color score with average score 4.72±0.05 as presented in (Table 3).

5.2.2. Aroma

The conclusion of treatments on aroma of quinoa supplemented cookies exposed that significantly highest accepted aroma value was gained by T_1 (cookies prepared by supplementation of 10% quinoa flour) with mean score of 8.43±0.04 correspondingly. Whereas, T_1 and T_0 as well as T_0 and T_2 were statistically similar with respect to each other. Although, aroma score was gained by T_5 with average score 7.42±0.10, significantly lowest as displayed in (Table 3).

5.2.3. Taste

The consequence of treatments on taste of quinoa supplemented cookies defined that the highest taste score was gained by T_1 (cookies made by supplementation of 10% quinoa flour) significantly highest mean score of 8.08±0.05 respectively. Whereas the lowest taste score was gained by T_5 with average score 5.37±0.04 significantly lowest as presented in (Table 3).

5.2.4. Crispiness

The statistical consequences regarding crispiness of quinoa powder supplemented cookies indicated that the influence of treatments (levels of quinoa powder supplementation) and storage duration on color of cookies was originated significantly high. Although, the combine outcome of treatments (levels of quinoa supplementation) and storage period on crispiness of the product was exposed to be non-significant as given in Table 3.

The influence of treatments on crispiness of quinoa supplemented cookies illustrated that the crispiness score was given to T_0 (cookies without quinoa flour supplementation) significantly highest with mean score of 8.53±0.11correspondingly. Although the crispness score was gained by T_5 significantly lowest with average score 7.70±0.06 as shown in (Table 3).

5.2.5. Volume

The influence of treatments on volume of quinoa supplemented cookies exhibited that significantly the highest volume score was given to T_0 (cookies without quinoa flour supplementation) with mean score of 8.69±0.06 respectively. The significantly the lowest volume score was given to 12^{th} day storage with mean score 7.10±0.03 as shown in (Table 3).

5.2.6. Texture

The influence of treatments on texture of quinoa supplemented cookies demonstrated that the texture score given to $T_0$was significantly highest (cookies without quinoa flour supplementation) with mean score of 8.44±0.05 correspondingly. Although, the texture score given to T_5 with mean score of 6.40±0.08 was significantly lowest as presented in (Table 3).

The influence of treatments on over all acceptability of quinoa supplemented cookies demonstrated that the overall acceptability score given to T_0 (cookies without quinoa flour supplementation) was significantly highest with mean score of 8.09±0.06 correspondingly. Although the overall acceptability score was gained by T_5 was significantly lowest with average score 5.55±0.07 as displayed in (Table 3).

Table 1: Chemical composition of quinoa flour

Parameters	Results
Moisture %	9.5±1
Crude protein %	14.33±0.25
Crude Fat %	5.13±0.44
Crude fiber %	13.33±0.52
Ash%	2.77±0.21
NFE	54.93±0.88
Total phenolic contents µg GAE/g	1203.62±7.21
K mg/100g	796.51±25.11
Mg mg/100g	216.17±3.8
Ca mg/100g	33.11±0.3
Fe mg/100g	4.77±0.04
Zn mg/100g	3.45±0.01

Table 2: **Physiochemical Analysis of Quinoa supplemented cookies**

Treatments	Physiochemical Analysis						
	Moisture (%)	**Crude Protein (%)**	**Crude Fiber (&)**	**Crude Fat (%)**	**Ash (%)**	**NFE**	**TPC**
T0 (control)	2.76±0.04	7.17±0.05	1.44±0.03	18.27±0.20	1.19±0.01	60.46±0.04	716.87±5.89
T1	2.76±0.05	7.33±0.01	1.99±0.01	18.20±0.03	1.31±0.01	60.38±0.06	813.01±2.44
T2	2.68±0.05	7.56±0.00	2.51±0.03	19.05±0.02	1.43±0.01	60.18±0.03	927.69±1.36
T3	2.74±0.01	8.06±0.03	2.95±0.03	19.52±0.02	1.58±0.02	60.16±0.04	1043.06±4.07
T4	2.81±0.05	8.66±0.03	3.22±0.02	20.04±0.03	1.77±0.02	60.00±0.08	1143.45±2.41
T5	2.66±0.01	9.06±0.01	3.94±0.03	20.98±0.04	1.98±0.01	59.88±0.06	1283.92±3.14

Table 3: Sensory evaluation of quinoa supplemented cookies

Treatment	**Parameters**						
	Color	**Aroma**	**Taste**	**Texture**	**Volume**	**Crispness**	**Overall acceptability**
T0	8.28±0.07	8.36±0.09	7.96±0.05	8.44±0.05	8.69±0.06	8.53±0.11	8.09±0.06
T1	7.93±0.05	8.43±0.04	8.08±0.05	8.17±0.02	8.41±0.04	8.32±0.04	7.90±0.09
T2	7.61±0.10	8.31±0.05	7.86± 0.09	7.91±0.05	7.93±0.02	8.32±0.05	7.74±0.09
T3	6.75±0.07	7.98±0.08	6.60±0.08	7.15±0.03	7.75±0.03	8.22±0.04	6.79±0.17
T4	5.74±0.04	7.66±0.04	5.91±0.08	6.83±0.04	7..47±0.02	7.87±0.04	6.23±0.05
T5	4.72±0.05	7.42±0.10	5.37±0.04	6.40±0.08	7.10±0.03	7.70±0.06	5.55±0.07

6. CONCLUSION

The purpose of the present study was to develop the Quinoa (*Chenopodium quinoa*) supplemented cookies. The cookies were backed by using main ingredients of cookies along with different ratio of quinoa flour in different These cookies were analyzed from different parameters with storage intervals of 0, 2, 4, 6, 8, 10, and 12 days for their physical, chemical results and storage strengths. The consequences obtained to this storage studies are demonstrated and debated in this part.

The spread factor of cookies showed that the spread factor ratio was ranged from 10.74±0.01 to 9.51±0.01 due to variation in treatment and storage duration. The moisture ratio of the product was enhanced with increment in quinoa concentration as well as storage period. The moisture contents of cookies were ranged from 2.51±0.01% to 3.01±0.05% due to variation in treatment and storage period.

The effect of treatments on protein percentage of quinoa supplemented cookies exposed that significantly the highest protein ratio were given to T_5 (cookies with 50% quinoa flour supplementation) followed by the protein contents were given to T_4 (cookies prepared by supplementation of 40% quinoa flour).The consequence of storage duration on protein contents of

quinoa supplemented cookies indicated that significantly the highest contents of protein were detected at zero day of storage followed by the contents of the protein at 2nd day of storage while the lowest contents of protein were detected at the end of the experiment. The contents of protein were vary from 9.11±0.01% to 7.15±0.04% due to variation in treatment and storage duration. The contents of ash of cookies were ranged from 2.01±0.01% to 1.17±0.01% due to variation in treatment and storage period.

The contents of fat were witnessed significantly highest in T_5 (cookies with 50% quinoa flour supplementation) followed by the fat contents in T_4 (cookies prepared by supplementation of 40% quinoa flour). The fat contents were ranged from 21.01±0.03% to 18.23±0.20% due to variation in treatment and storage duration. The sensory evaluation of the cookies discovered that T_1 (cookies prepared by supplementation of 10% quinoa flour) was closest to the control treatment however the quinoa supplementation up to 20% was acceptable with respect to organoleptic properties.

On the basis of these results it was determined that the quinoa supplemented cookies can be prepared with replacement of wheat flour with that of quinoa flour up to 20%. Above this concentration there was negative impact on quality of quinoa specially color and taste.

7. DISCUSSION

Quinoa seeds are not true grains and not considered as fruit so they are considered as pseudo-cereal as well as pseudo oil seeds. The present study was designed to develop quinoa supplemented cookies by using quinoa flour to overcome the threat of malnutrition. For this, quinoa flour was produced through milling process and analyzed for nutritional profiling. Afterwards quinoa supplemented cookies was developed by using various levels of quinoa flour. Then physico-chemical as well as organoleptic properties of these quinoa supplemented cookies was Results indicated that the quinoa grains showed high nutritional profile with 14.33±0.25% protein, 5.13±0.44% fat, 13.33±0.52% fiber 2.77±0.21% ash and54.93±0.33% NFE. Quinoa supplemented cookies were acceptable by the consumer at 20% level of quinoa. Cookies proximate analysis showed in percentage, from 7.17±0.05 to 9.07±0.01 protein, from 1.19±0.01 to 1.98±0.01 ash, from 18.27±0.20 to 20.98±0.04 fat, from 1.44±0.03 to 3.94±0.03 fiber.

The results are also justified by the findings of the previous researchers (Hooda and jood, 2005; Baljeet *et al*., 2010) who described that when the wheat flour was supplemented with other cereal flour such soy flour and buckwheat then the spread factor of the product reduced. On the other hand, when the quantity of protein increased, cookies also showed decreased in spread factor (Singh and Muhammad, 2007; Yamsa-eng-sung *et al*., 2012). The results for spread factor during storage study were justified by Hussein *et al.* (2011) who also reported that there was non-significant effect on the spread factor of cookies.

The proximate analysis results for different treatments of the quinoa supplemented cookies were also found similar according to previous researches such as the cookies of control sample have lowest quantity of protein, fat, ash, fiber, and NFE as compared to the quinoa supplemented cookies because many scientists reported that the quantity of protein, fiber, fat and ash, quinoa grains is much more than wheat flour and in contrary NFE decreased (Alvarez-Jubete *et al*., 2010). The results of storage study was also justified by Brooker (1998) who reported that there was no significant changes occur in proximal results of good packed cookies.

The total phenolic contents result of currant study was also justified by the study of (Watanabe *et al*. 2003) who also stated that as the quantity of quinoa improved in cookies the TPC also increased. It is also

justified that the quinoa cereals grain have more quantity of TPC as compared to the wheat flour (Asao and Watanabe 2010) which might be a big reason of high quantity of TPC in quinoa supplemented cookies.

The results of the color of quinoa supplemented cookies were also justified according to the previous research of two scientists Lorenz and Coulter (1991). Who also reported that as quantity of quinoa flour increased in cookies the color became darker.

The results for different treatments on sensory analysis were justified by the findings of Baljeet *et al.* (2010) who also described that as the quantity of quinoa increased the sensory properties of cookies decreased such the color become dark, taste become bitter. So, according to the sensory properties it is only acceptable up to 20 % quinoa supplementation. Whereas the results of the storage duration on sensory of quinoa supplemented cookies was justified by Ade *et al.* (2015) who also reported that the slightly change occur in sensory properties of cookies during storage because during storage the enzymatic browning occur in cookies.

The results for the different treatments are justified by the findings of Watanabe *et al*. (2010) who also reported that the mineral contents are increased due to fortification of quinoa in wheat flour.

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9. CONFLICT OF INTEREST

There is no conflict of interest in my research.

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