

## APPLICATION OF A NEW CROP-QUINOA FOR FISH FEED

VESNA RADOVANOVIĆ, MIRJANA DEMIN, BRANKA ŽARKOVIĆ,  
RADMILA STIKIĆ, MIRJANA MILOVANOVIĆ  
*University of Belgrade, Faculty of Agriculture, Department of Food Technology,  
Nemanjina 6, 11000 Belgrade -Zemun, Serbia*

### PRIMENA NOVE KULTURE - KVINOJE U ISHRANI RIBA

#### *Apstrakt*

Kvinoja (*Chenopodium quinoa*, Willd.) je pseudocerealijska kultura koja se tradicionalno gaji na malim plantažama u ruralnim oblastima Južne Amerike u regionu Anda. Kvinoja je ratarska kultura, gajena za domaću upotrebu siromašnog stanovništva. Zbog sposobnosti prilagođavanja različitim agro-ekološkim uslovima, kvinoja može da se gaji u različitim regionima. Agrotehnika zasnovana na principima organske poljoprivrede i primenjena je u Danskoj, Italiji i Makedoniji. Zahvaljujući visokoj nutritivnoj vrednosti seme se koristi u ljudskoj ishrani, usled čega je poslednjih godina porastao interes za gajenje i preradu kvinoje, kao funkcionalne hrane. Poznato je da i lišće biljke poseduje značajne nutritivne vrednosti, pa se koristi kao zamena za spanać. Biljka može da poraste 1-3m visine, a plodovi su u obliku okruglog, malog semena, koje je obavijeno perigonijom različite boje (bledo žute, do svetlo crvene). Perigonijum se mehanički lako odvaja, kada je seme suvo. U perikarpu semena nalaze se saponini, nosioci karakterističnog gorkog ukusa semena kvinoje, zbog čega je potrebno iste odstraniti, pre upotrebe u ljudskoj ishrani.

U ovom radu predmet istraživanja je bila danska sorta KVL 37, gajena u okolini Beograda. Ispitivan je nutritivni sastav sirovog i oljušćenog semena kvinoje, kao novog useva i mogućnost njegove primene u ishrani riba. Poznato je da visokoa nutritivna vrednost semena kvinoje potiče od sadržaja proteina, različitih minerala i vitamina, i to E vitamin i vitamini B grupe. Prosečan sadržaj proteina varira od 8%-22%, a glavne proteinske frakcije čine albumini i globulini (44-47% ukupnih proteina). U ovom radu sadržaj proteina je varirao od 15,5% do 16,8%, u zavisnosti stepena čistoće semena. Seme poseduje odlično izbalansiran sastav amino kiselina, a izdvajaju se lizin, treonin i metionin, amino kiseline koje su uglavnom deficitarne u biljnim sirovinama. Glavnu komponentu semena kvinoje čine ugljeni hidrati, čiji sadržaj varira od 67% do 74%. Skrob čini oko 52-63%, dok su ostali ugljeni hidrati, kao i sirova vlakna malo

zastupljeni. Kvinoja sadrži 2% do 10% lipida, a dokazano je i prisustvo esencijalnih masnih kiselina, kao što su linolenska, oleinska i palmitinska. Značajan je sadržaj minerala tj. kalcijuma, gvožđa i cinka, ali se njihov sadržaj kvantitativno smanjuje u daljim postupcima ljuštenja, pranja i poliranja semena. U humanoj ishrani saponini i fitinska kiselina predstavljaju glavne nedostatke kvinoje. Ljuštenjem i daljim prečišćavanjem seme kvinoje je našlo primenu u ishrani ljudi kao varivo, hrana za doručak, za kolače za proizvodnju brašna, kao i za ishranu životinja u formi mekinja ili pogača. U našem radu, kod oljuštenog zrna, dokazano je značajno povećanje sadržaja ulja, dok je sadržaj sirovih vlakana i ukupnog pepela smanjen za oko tri-puta. Sadržaj skroba je u očekivanim graničnim vrednostima. U pogledu sadržaja minerala nije bilo većih promena. Imajući u vidu veličinu zrna, laku pripremu, nutritivni potencijal, kao i novu kulturu u našoj regiji, pokazano je da seme kvinoje može da nađe primenu i kao hrana za ribe.

*Ključne reči: kvinoja seme, kvalitet proteina, osobine ishrane*

*Keywords: quinoa seeds, protein quality, nutrition properties*

## INTRODUCTION

Quinoa (*Chenopodium quinoa* Willd.) is a seed crop traditionally cultivated in the Andean region for several thousand years. Quinoa is considered as a multipurpose agricultural crop. Genetic variability of quinoa is huge, with cultivars being adapted to growth from cold, highland climates to subtropical conditions, which makes it possible to select, adapt and breed cultivars for a wide range of environmental conditions (Bertero et al., 2004). In addition, the quinoa plants show tolerance to frost, salinity and drought, and have the ability to grow on marginal soils. Quinoa was successfully trialed in typical agro-climatic conditions of South Eastern Europe region. Quinoa has been tested in diverse climatic regions of USA, Canada, India, England, Denmark, Greece, Italy and other European countries (Bhargava et al., 2007; Jacobsen et al., 2003; Pulvento et al., 2010). The planting season varies from August in the Andean highlands, extending through December and in some areas from January to March. Quinoa is harvested at physiological maturity, which may be reached within 70 to 90 days after flowering. Depending on the variety, plants take between 5 and 8 months to mature. Quinoa plant grows 1-3 m high. The fruit of quinoa is in the form of the seeds which are small, round and flattened, measure about 1.5 mm in diameter and about 350 seeds weigh 1 g and can germinate very fast. They are covered by perigonium, which is of the same color as the plant: white, yellow, gray, light brown, pink, black or red. It is easily removed when it is dried (Demin et al., 2012).

The quinoa seeds, also known as Inca-rice, were traditionally used as a basic component in the diet. The seeds may be utilized for human food, in flour products and in animal feedstock because of its high nutritive value (Repo-Carrasco et al., 2003). Saponins and phytic acid are the main disadvantageous factors in quinoa. Quinoa contains saponins in the amount from 0.1 to 5%. The pericarp of the quinoa seed contains saponins which may impart a bitter taste. Their separation is easily accomplished by rinsing the seed in cold alkaline water or by mechanical abrasion (Jancurova et al., 2009).

The aim of this work was to examine the nutritional potential of the quinoa seeds, as a new crop in the fish feed application. Protein quality, starch properties and other nutrients of the quinoa seeds have been studied.

## MATERIALS AND METHODS

**Materials.** Quinoa (*Chenopodium quinoa* Will.) seeds were produced in the vicinity of Belgrade, in a field of the agroindustrial complex "Stara Pazova", harvest season was 2010. Quinoa (*Chenopodium quinoa* Willd.) variety used for investigation was Puno (KVL 37), provided by the University of Copenhagen. The variety has recently been registered as a new quinoa variety in Europe, bred from Chilean and Peruvian landraces and selected for earliness and adaptation to European conditions. The raw and flaky quinoa seeds were manually dehulled to remove the pericarp. Manual dehulling was done by using abrasive action in the pestle and mortar, and the hulls were separated carefully by sieving to avoid inclusion of other seed portions (Chauhan et al. 1992).

**Chemical analyses.** The seeds were milled in Cemotek Sample Mill Foss, Sweden and the flour was further examined. Standard AOAC methods (AOAC, 1997) numbers 925.10, 923.03 and 920.87 were used to determine moisture, ashes and protein (Kjelttec 2300 system) contents, respectively. The nitrogen to proteins conversion factor of 6.25 was used for the calculation of crude protein content. Automatic extraction method AOAC number 920.39 (FOSS-TEKATOR SOXTEC AVANTI) was used for oil content. Fibertek 2010 System was used to describe crude fiber content, using 962.09 AOAC describe method. According to Grosso et al., 2000 the total starch content was calculated.

## RESULTS AND DISCUSSION

The quinoa seeds produced in the field experiment were evaluated for nutritive value in order to investigate her potential as a new fish feed. The main chemical and nutritive parameters of row and dehulled quinoa seeds that were estimated are presented in Table 1.

**Table 1.** Chemical and mineral composition of the Quinoa seeds (Grams per 100g of the fresh weight samples)

Composition (%)	Row Quinoa seeds	Dehulled Quinoa seeds
Moisture	10.70	10.56
Protein	<b>16.68</b>	<b>15.61</b>
Oil	2.42	4.06
Crude fiber	9.89	2.98
Ash	7.67	2.99
Starch	52.64	63.80
P (g/kg)	0.38	0.22
Ca (g/kg)	0.44	0.35
NaCl	0.46	0.37
Na	0.18	0.14

High nutritional value of quinoa seeds is mainly due to the high protein content and additionally the wide range of minerals and vitamins. The protein content of quinoa seeds varies from 8% to 22% and is higher in comparison with wheat, rice or other cereals, i.e. 8-14%. Here protein varied from 15,5% to 16,8% depending of the the degree of purification. Quinoa also has a good balance of the amino acids. The seed proteins are rich in amino acids like lysine, threonine and methionine (Fleming and Galwey, 1995, Stikic et al., 2012).

The main component in quinoa seeds consists of carbohydrates and varies from 67% to 74% of the dry matter. Starch is the main component in both seeds makes about 52-63%. The other carbohydrates were found in small amounts (Jancurova et al., 2009). Purification method which was undertaken significantly reduced the crude fiber and ash content for about tri-fold times. On the contrary, the oil content increased for 60%. Quinoa contains from 2% to 10% oil. The overall fatty acid composition of the whole quinoa seeds was similar to the other cereal grains with essential linoleic, oleic and palmitic acids as the major acids present. Quinoa seeds contain calcium, magnesium, iron and zinc, as the common cereals. Finally, reducing the mineral content is expected, as we previously reported (Stikic et al., 2012).

## CONCLUSION

Quinoa (*Chenopodium quinoa* Will.) seeds were obtained from the fields in the vicinity of Belgrade. Chemical composition revealed the potential of the row and dehulled seeds as a valuable source of protein, crude fiber and calcium. The results showed the possibility of development of a nutritionally valuable crop, as a rich source of high quality protein and oil in the application for fish feed.

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