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Volume 9 (6); November 25, 2019

Research Paper**Diagnostic informativity of the volume MDCT-angiography and MR-cholangiography in the pre- and intraoperative periods for the examination of donors of a liver fragment.**

Nazirov FG, Djuraeva NM, Vakhidova NT, Omonov OA and Salimov UR.

J. Life Sci. Biomed., 9(6): 151-156, 2019;

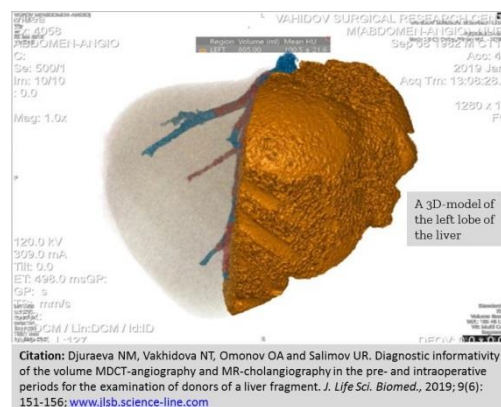
pii:S225199391900024-9

Abstract

Introduction. The first transplantation of a liver fragment from a living donor was performed in Uzbekistan on February 12, 2018 at the Republican Specialized Scientific Practical Medical Center of Surgery named after acad.V. Vakhidov. This event laid the foundation for a new direction for domestic clinical practice that meets the current level of world medicine development.

Aim. The aim of the study was to determine the diagnostic information content of preoperative data of the volume multi detector computed tomography (MDCT) angiography and magnetic resonance cholangiography (MRCG) when compared with intraoperative ones at examining related donors for liver fragment transplantation (LFT). **Methods.** Total of 88 potential donors of a liver fragment aged from 19 to 58 years (53 men and 35 women) were examined for the period 2017-2019. Sixteen donors were undergone liver resection to obtain a transplant: the right lobe of the livers in 12 people and the left lobe in 4 people. **Results.** Compared with intraoperative data, the main arteries supplying the transplant planned for resection were identified with MDCT-angiography in 98.4% of cases ($P < 0.05$). Variations of the portal bed according to MDCT-angiography in comparison with intraoperative ones were determined in 93.8% of cases ($P < 0.05$). Intraoperatively revealed the main trunks of the venous outflow were determined by MDCT-angiography in 95.7% of cases ($P < 0.05$). **Recommendation.** We suggest that MDCT angiography and MRCG is a highly informative and important method for estimation the condition of the liver in transplant planning.

Keywords: Liver transplant, Contrast agent, MDCT-angiography, Magnetic resonance cholangiography.



Citation: Djuraeva NM, Vakhidova NT, Omonov OA and Salimov UR. Diagnostic informativity of the volume MDCT-angiography and MR-cholangiography in the pre- and intraoperative periods for the examination of donors of a liver fragment. *J. Life Sci. Biomed.*, 2019; 9(6): 151-156; www.jlsb.science-line.com

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Review**Genetically modified foods (GMOs); a review of genetic engineering.**

Gatew H and Mengistu K.

J. Life Sci. Biomed., 9(5): 157-163, 2019;

pii:S225199391900025-9

Abstract

Aim. This review article mainly focuses on the importance, possible risks and state of public debate on genetic engineering particularly on genetically modified organisms (GMOs). During the last decade, tremendous progress has been made in the area of genetic engineering. The technology has numerous applications in increasing productivity of agriculture (in farm animal and plant species) and biomedical industries. Creation of resistant varieties of plants, transgenic animals, increasing the protein content, bio-fertilization, recombinant pharmaceuticals and gene therapy are now the major application of genetic engineering. Despite the technology has opened up new opportunities for highly specific manipulation of the genetic material of organisms, it has the possible risks of genetic contamination/inbreeding, competition with natural species, ecosystem damage, risk of horizontal gene transfer, new kinds of outbreak diseases; creation of drug resistant germs; accidental escape of laboratory strains and increased disease burden if the recipient organism is a pathogenic microorganism or virus. Additionally, now, scientists are faced with ethical issue challenges related to moral and religious acceptance and animal welfare. **Conclusion.** Scientists need to consider the types of applications of genetic engineering which will appear on the commercial market as well as develop procedures which will minimize potential biological and ecological hazards of the technology. Even though, genetically modified foods currently available on the international market have passed safety assessments, countries vary in their regulation of genetically modified foods indicating the necessity of worldwide consensus on labelling and traceability of genetically modified foods taking into account health and environmental risks as well as religious issues.

Keywords: Preterm Acceptance, Benefits, Biological and ecological hazards, Ethics, Farm animal, Genetically modified organisms (GMOs), Human health, Plant



Citation: Gatew H and Mengistu K. Genetically modified foods (GMOs); a review of genetic engineering. *J. Life Sci. Biomed.*, 2019; 9(5): 157-163. www.jlsb.science-line.com

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Research Paper

***In vitro* nematocidal activity of Juglone against *Meloidogyne incognita* race 2 infesting pomegranate.**

Laxmikant D.

J. Life Sci. Biomed., 9(6): 164-169, 2019;

pii:S225199391900026-9



Abstract

Introduction. *Juglans regia* L. (walnut) is also known as the medicinal plant and native to the mountain ranges of central Asia. Recently, a severe infestation of root-knot nematodes (RKN, identified as *Meloidogyne incognita* race 2), was observed on *Punica granatum* L. (pomegranate). **Aim.** The present study aimed to investigate the effect of *in-vitro* nematocidal activity of the purified bioactive compounds (Juglone: 5-Hydroxy 1, 4-Napthoquinone) isolated from medicinal plant like walnut on *Meloidogyne* species associated with pomegranate under field conditions. **Methods.** Plants are cultivated at the agricultural farm in Solapur, (M.S.), India. **Results.** Roots of infected plants were heavily galled and soil samples collected from the affected plants second stage juveniles (J2). The ability of treatment schedule of Juglone was tested using an in-vitro method against RKN - *Meloidogyne incognita* race 2 infesting pomegranate. Juveniles in the control (distilled water; carbofuran) were compared with treated groups. The Juglone showed a 100% mortality in 5 µl/ 10 ml of distilled water/ 100 nematodes.

Keywords: 5-Hydroxy 1, 4-Napthoquinone, Nematicidal activity, Root-knot nematode, *Punica granatum* L.

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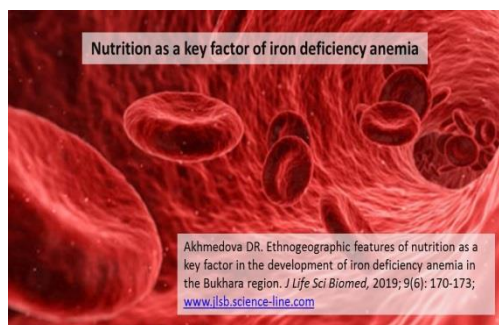
Research Paper

Ethnogeographic features of nutrition as a key factor in the development of iron deficiency anemia in the Bukhara region.

Akhmedova DR.

J. Life Sci. Biomed., 9(6): 170-173, 2019;

pii:S225199391900027-9



Abstract

Introduction. Ecological disasters, industrial pollution, and poor nutrition lead to significant changes in the content of microelements (MEs) in food and, as a consequence, in the human body, while toxic MEs accumulate, displacing essential ones. Iron deficiency anemia refers to biogeochemical poly-microelementosis. For the prevention and treatment of iron deficiency anemia (IDA), drugs containing microelements are used along with traditional methods of treatment. **Aim.** This study aimed to investigate the nutritional characteristics and the ME content in the diet in order to clarify the etiology of IDA, the role of microelementosis in its development, and to also identify indicators of red blood parameters in families living in the Qorovulbozor district of the Bukhara region. **Methods.** Ten families were examined, each consisting of a husband, a wife, and female children. In order to facilitate the analysis of the results obtained, the husbands and wives selected for examination from those were aged between 30 and 45 with daughters from 12-17 years old. The content of MEs in erythrocytes and blood serum, in tap water, and in irrigation ditch (arch) water was determined. **Results.** A relatively favorable picture was observed only in men, while 1-3 degree IDA was observed with almost the same frequency in both mothers (75-78.5%) and their daughters (20-21.4%), respectively. Daily nutrition was roughly estimated by dividing the volume of food consumed per week into 7 days and the number of family members. Despite this, iron deficiency turned out to be significant for such products as meat, milk, bread, eggs, and fruit. This served as the basis for convincing the subjects of the need for proper nutrition and the administration of ME containing preparations (Vitrum Prenatal Forte). **Conclusion.** In order to exclude the entry of toxic MEs into the body, it is advisable to use mineral water for food, especially during pregnancy, instead of tap water. Our findings provide the basis for the need to correct the ME composition of the body with the necessary MEs, not only by increasing the volume and quality of food products, but also by using medications containing MEs.

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Diagnostic informativity of the volume MDCT-angiography and MR-cholangiography in the pre- and intraoperative periods for the examination of donors of a liver fragment

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ABSTRACT

Introduction. The first transplantation of a liver fragment from a living donor was performed in Uzbekistan on February 12, 2018 at the Republican Specialized Scientific Practical Medical Center of Surgery named after acad.V. Vakhidov. This event laid the foundation for a new direction for domestic clinical practice that meets the current level of world medicine development. **Aim.** The aim of the study was to determine the diagnostic information content of preoperative data of the volume multi detector computed tomography (MDCT) angiography and magnetic resonance cholangiography (MRCG) when compared with intraoperative ones at examining related donors for liver fragment transplantation (LFT). **Methods.** Total of 88 potential donors of a liver fragment aged from 19 to 58 years (53 men and 35 women) were examined for the period 2017-2019. Sixteen donors were undergone liver resection to obtain a transplant: the right lobe of the livers in 12 people and the left lobe in 4 people. **Results.** Compared with intraoperative data, the main arteries supplying the transplant planned for resection were identified with MDCT-angiography in 98.4% of cases ($P<0.05$). Variations of the portal bed according to MDCT-angiography in comparison with intraoperative ones were determined in 93.8% of cases ($P<0.05$). Intraoperatively revealed the main trunks of the venous outflow were determined by MDCT-angiography in 95.7% of cases ($P<0.05$). **Recommendation.** We suggest that MDCT angiography and MRCG is a highly informative and important method for estimation the condition of the liver in transplant planning.

Original Article

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INTRODUCTION

The undoubted advantage of receiving a transplant from a living donor in the planned preparation of related donors and the possibility of a qualitative choice of donor hepatic parenchyma is an important factor for a favorable prognosis of the surgery's outcome. Negative hemodynamic and drug effects are practically excluded for the donor in the case of a related transplantation at the preoperative stage [1-4]. The indisputable advantage of a liver fragment transplantation (LFT) from a living related donor is independence from the system of providing cadaveric organs, which means that planning the timing of the operation depending on the state of the recipient [5-10].

In contrast to cadaveric liver transplantation, the use of an organ fragment from a close relative allows to count on its more favorable immunological adaptation in the recipient's body [11-13]. The first transplantation of a liver fragment from a living related donor was performed in Uzbekistan on February 12, 2018 at the Republican Specialized Scientific Practical Medical Center of Surgery (RSSPMCS) named after acad. V.Vakhidov. This event laid the foundation for a new direction for domestic clinical practice that meets the current level of world medicine development [12, 14].

All main disadvantages of related liver transplantation are associated with a potential risk to the health and life of the donor which causes certain skepticism and ethical questions among the general medical community. Thereby, one of the important aspects of planning the surgery of related donors is a detailed examination of the selected potential donor [11, 15-20]. After conducting clinical and laboratory studies instrumental examination methods are performed at the final stage, which includes volume MDCT angiography and magnetic resonance cholangiography (MRCG). The main task is to clarify the technical capabilities of obtaining a full-fledged liver transplant while fully preserving the possibilities of donor rehabilitation. It is necessary to determine the following for doing this: 1) the size and weight of the donor liver fragment to be removed and the remaining part (liver stump); 2) an anatomical version of the circulatory system structure

entering the porta of the donor liver, venous outflow from the organ and architectonics of the biliary system [13, 21-24]. Since its introduction to the clinics, MDCT angiography has become the main method of instrumental examination of related donors of a liver fragment [2, 6, 16, 25, 26]. In accordance with the requirements of transplant doctors, a special MDCT scan protocol (all in one) was developed, which includes four phases of the study: native, arterial, portal and venous [27-31]. To determine the diagnostic information content of the preoperative results of volume MDCT angiography and MRCG in the rebound of potential liver donors, as well as their comparison with the intraoperative anatomical picture.

MATERIAL AND METHODS

Ethical approval

The review board and ethics committee of RSCS named after acad. V.Vakhidov approved the study protocol and informed consents were taken from all the participants.

Total of 88 potential donors of a liver fragment – 53 men and 35 women – aged from 19 to 58 years (the mean age was 34.1±9.06 years) were examined. All patients were examined in RSSPMCS named after acad.V. Vakhidov for the period 2017-2019. At the time of the present study, 16 donors were undergone liver resection to obtain a transplant: in 12 people (the right lobe, RL), in 4 people (the left lobe of the liver, LL). All related donors underwent four-phase MDCT angiography and MRCG of liver. The investigations were carried out on the wide-detector MDCT (Aquilion One - 640 Genesis, Cannon, Japan), as well as MRI on the Signa HDxt with a magnetic field of 1.5 T (GE). The rate of contrast agent (CA) introduction was 5.0–5.5 ml/sec, the amount of CA varied 100±10 ml (Unigexol 350).

MDCT investigation began with an inserting of the catheter into the external cubital vein followed by the placement and instruction of the patient about the progress of the upcoming procedure. An automatic syringe-injector of the “Ulrich” company was used for injection, having previously collected 100-120 ml of an iodine-containing contrast preparation into the flask for injection with an iodine concentration of 350-370 mg / ml and an injection rate of 4.5-5.0 ml/s. The selection protocol in this case was a multiphase scanning protocol with selected parameters, which included a native study, arterial, portal and delayed phases (phase of the hepatic veins) scans performed on one breath hold in each phase (Table 1). Magnetic resonance imaging (MRI) investigation of the patient began with laying on his back using a surface receiving coil for the body. The following programs are used for the bile ducts investigation. A) Localizer (sighting image); B) T2–COR 2D FIESTA FATSAT (breath holding) - for more precise setting of slices for the MRCG program; C) 3D MRCG program without holding one’s breath, but using the 3D MRCG Rtr ASSET navigator-the program is synchronized with the movement of the diaphragm. The main parameters of the MRCG programs are shown in Table 2.

Table 1 - Main parameters of the MDCT scanning programs

Parameters	Arterial phase	Portal phase	Delayed phase (phase of the hepatic veins)
Level	Liver hilum	Liver hilum	Liver hilum
Scan delay: Duration of study phases, automatic bolus tracking	15-20 sec 120 +HU	30-40sec	50-60sec
Tube voltage (kV)	120	120	120
Effective mas/ Quality ref mas	140	140	140
Rotation time	0.5s	0.5s	0.5s

Table 2. The main parameters of the MRCG programs

Parameters	COR 2D FIESTA FATSAT	3D MRCG Rtr ASSET
Layer	1	1
Quantity of slices	15-20	40-50
Diet factor	0	50%
FOV	300-330 mm	380 mm
FOV phase	100%	100%
Slice thickness	3-4.5 mm	1.5 mm
TR	1240 m/s	1800 m/s
TE	87 m/s	681 m/s
Averaging	1	1
Flip angel	150 deg.	170 deg.
Fat sat (with fat suppressed)	+	-

RESULTS AND DISCUSSION

Up to and during conducting this research, 16 (18.4%) of the 88 potential examined donors have been operated on to collect a liver fragment. In RSSPMCS named after acad.V. Vakhidov, 4 liver transplants were performed, and the rest were operated on at Yashoda Hospital (India). Depending on the anthropometric data of the recipient, the volume of the transplant and the resected share of the donor were determined. Resection of the right lobe of the liver in order to obtain a transplant from the right lobe was performed in 12 (75%) donors and in 4 (25%) the left lobe of the liver was used as a transplant. The vascular and biliary anatomy of the liver and the mass of the resected liver fragment were also examined during the surgery.

During the surgery performed in donors it was revealed that in 8 (66.6%) from 12 who were resected the right lobe of the liver, the source of arterial circulation was own hepatic artery (OHA) extending from the celiac trunk, which corresponded to type I according to MDCT angiography and was identified in 7 (58.3%) donors at the preoperative stage. In 3 donors (25%) we revealed a discharge of the right hepatic artery from the common hepatic one which corresponds to type II at MDCT and was detected in 4 (33.3%) donors. In 1 donor (8.3%) we registered a discharge of the right hepatic artery (RHA) from the superior mesenteric artery (SMA), which corresponded to type IV at MDCT.

In 4 donors the left lobe of the liver was used as a transplant. Intraoperatively, it was revealed that in 3 (75%) donors the left lobe was supplied from the OHA basin, which corresponded to type I according to MDCT and was detected in 3 (75%) donors. There was an abnormality of the left hepatic artery (LPA) from the total hepatic artery (OPA) in 1 donor (25%) which corresponds to type II according to MDCT and completely coincided with preoperative data. In all operated 16 donors blood supply of segment IV of the liver was also evaluated intraoperatively. Moreover, in 10 ($62.5 \pm 5.2\%$) of them blood supply was carried out due to the left lobar hepatic artery. Blood supply of the segment IV from the right hepatic artery was detected in 4 ($25 \pm 4.1\%$) donors and in 2 ($12.5 \pm 3.5\%$) a mixed type was revealed (left and right hepatic arteries). All donors were performed 3D reconstruction of the arterial bed of the liver (Figure 1). When evaluating the portal vein in 14 ($87.5 \pm 3.6\%$) of the 16 operated donors, type I of portal vein (PV) branching (classical) was revealed. Trifurcation of the portal vein was detected in 1 donor ($6.25 \pm 2.4\%$) and in 1 donor at MDCT it was described as trifurcation, but type I was intraoperatively detected due to the close separation of the branch of the liver segment VI from bifurcation. 3D models of the liver portal bed were also reconstructed (Figure 2).



Figure 1. 3D-reconstruction of the arterial bed of the liver and abdominal aorta



Figure 2. 3D-model of the liver portal bed

An intraoperative assessment of venous outflow from the liver revealed that type I was detected in 9 (56.3%) patients - this is a separate inflow of the right hepatic vein (RHV), the median hepatic vein (MHV) and the left hepatic vein (LHV) into the postcava. In 4 cases (25%), type II of PV branching was observed, it was when MHV and LHV fell into a single mouth and type III, fusion of MHV and LHV into a single trunk was observed in 3 (18.7%) donors. In 12 donors who performed right-sided liver resection, RHV fell into postcava as a single trunk. Along with RHV in 2 donors (12.5%), an additional right vein from the segment VIII of the liver independently flowing into postcava was revealed. In 1 donor (6.3%), an additional lower right hepatic vein from the segment V to MHV was noted, which was reflected in the MDCT protocol. In 7 donors (43.7%), small additional lower right hepatic veins flowing into postcava were revealed intraoperatively. These small branches were hemodynamically insignificant and were ligated during the resection. 3D models of venous outflow of the liver were also used for volumetry of the liver (Figure 3).

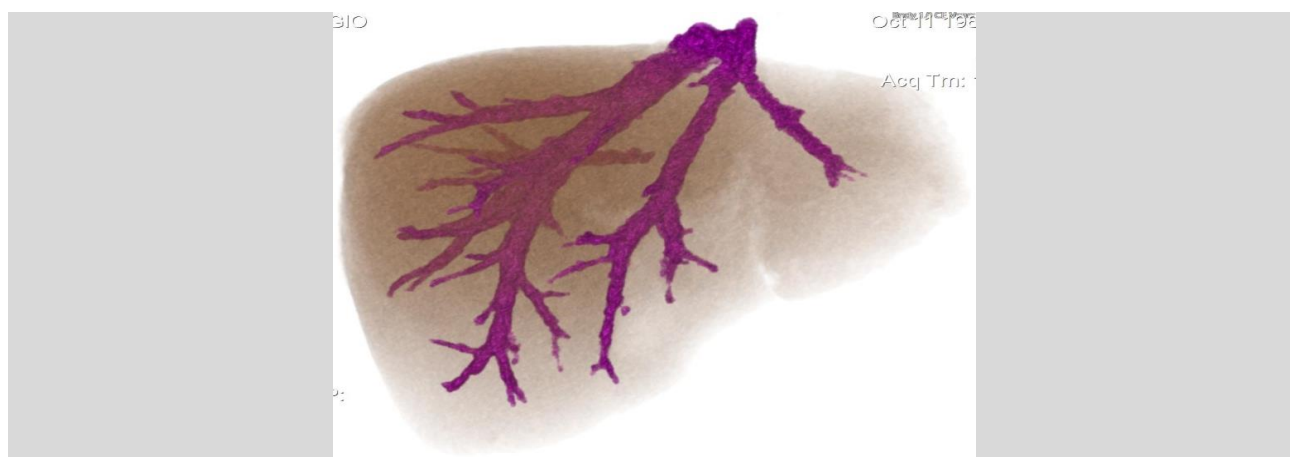


Figure 3. 3D-reconstruction of the liver venous outflow

The transplant volume

When weighing during the operation the obtained transplant, the mass of the right lobe ranged from 560-1420 grams, the mass of the left lobe – from 240 to 670 grams. When calculating the volume of the transplant, absolute coincidence with intraoperative data was observed in 3 donors (18.7%) of the right lobe and in 1 donor (6.2%) of the left lobe of the liver. For the purpose of additional analysis of the obtained data, axial images obtained during MDCT angiography in the Digital Imaging and Communications in Medicine (DICOM) format were processed using the Vitrea (version 7.4.0.462, Vital Images) software, which allowed us to build virtual objects of the zones of interest to us and to study, based on 3D maps, the relative position of the vascular structures of the liver, as well as visually assess the future fragment of the liver and calculate the volume of the future transplant. Examples of reconstructed 3D maps are shown in Figures 4 and 5.

Comparative data of MRCG with intraoperative ones were as follows. It was revealed that diagnosed type I on MRCG was detected in 13 (82%) from 16 operated patients. In 1 donor (6.2%), type I was determined on MRCG before the surgery, but type II was detected during surgery, which was explained by the close parallel lining of two right segmental ducts. In 1 donor (6.2%), 3 mouths of the bile ducts were revealed which corresponded to type III and was explained by the close fusion of two branches of the right anterior bile ducts to confluence. And in 1 (6.2%) donor we revealed 2 mouths of the transplant of the liver left lobe. Diagnostic informativity and accuracy of MDCT angiography in determining options and types of arterial and portal blood supply to the liver, as well as venous outflow pathways are presented in Table 3 ($P < 0.05$). Comparison of MDCT angiography and intraoperative data showed that the average error for the right lobe was 100 ± 21.8 grams, for the left lobe 42.2 ± 5.3 grams ($P < 0.05$; Table 4). Diagnostic informativity and accuracy of MR cholangiography in determining biliary ducts are presented in Table 5 ($P < 0.05$).

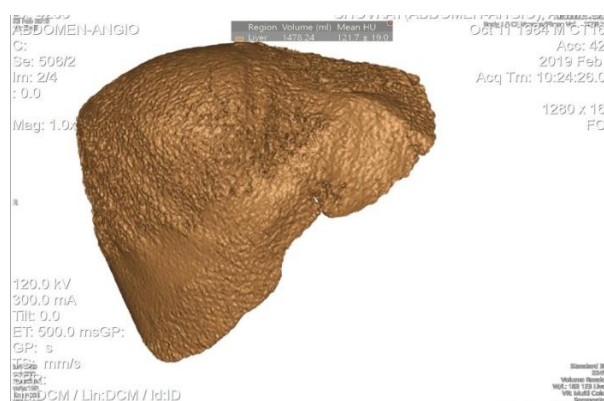


Figure 4. 3D-model of the liver in the frontal projection

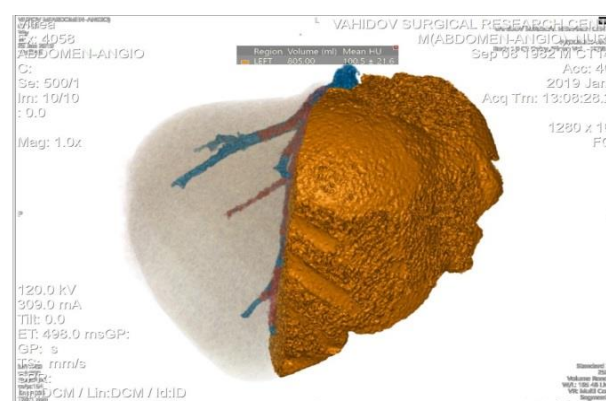


Figure 5. A 3D-model of the left lobe of the liver

Table 3. Diagnostic informativity of MDCT angiography in comparison with intraoperative data

Rates of the method informativity	Arterial blood supply of the liver	Variant of portal blood supply to the	Main ways of venous outflow
Sensitivity %	96.8	97.1	95.9
Accuracy %	92.5	93.7	91.3

Citation: Nazirov FG, Djuraeva NM, Vakhidova NT, Omonov OA and Salimov UR. Diagnostic informativity of the volume MDCT-angiography and MR-cholangiography in the pre- and intraoperative periods for the examination of donors of a liver fragment. *J. Life Sci. Biomed.*, 2019; 9(6): 151-156; DOI: <https://dx.doi.org/10.36380/scil.2019.jlsb24>

Table 4. The average mass of the liver fragment (transplant) obtained on MDCT angiography and during surgery

Liver fragments	The average mass of the alleged transplant according to MDCT, grams	The average mass of the liver fragment obtained intraoperatively, grams
Right lobe	811.7±30.5	788.8±27.2
Left lobe	327.5±31.3	369±37.8

Table 5. Diagnostic informativity of MR cholangiography vs. intraoperative data

Rates of method informativity	Right lobar duct	Left lobar duct
Sensitivity %	96.8	97.1
Accuracy %	92.5	93.3

CONCLUSION

According to preoperative MDCT angiography, the most common variant anatomy of the arterial blood supply to the liver was type Michels [31] classification, type I portal blood circulation according to Nakamura et al. [31] and type I venous outflow from the liver according to Soyer [32], which were determined intraoperatively at 95.7 % cases ($P<0.05$). MDCT angiography and MRCP in the definition of variant anatomy were 97.8% and 96.8%, respectively. The volume (mass) of the planned liver transplant obtained with MDCT volumetry was confirmed with intraoperative data in 92.8% ($P<0.05$). The data obtained indicate the high information content and the importance of these methods in planning liver transplantation.

DECLARATIONS

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Authors' contributions

All authors contributed equally to this work.

Competing interests

The authors declare that they have no competing interests.

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Genetically modified foods (GMOs); a review of genetic engineering

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ABSTRACT

Aim. This review article mainly focuses on the importance, possible risks and state of public debate on genetic engineering particularly on genetically modified organisms (GMOs). During the last decade, tremendous progress has been made in the area of genetic engineering. The technology has numerous applications in increasing productivity of agriculture (in farm animal and plant species) and biomedical industries. Creation of resistant varieties of plants, transgenic animals, increasing the protein content, bio-fertilization, recombinant pharmaceuticals and gene therapy are now the major application of genetic engineering. Despite the technology has opened up new opportunities for highly specific manipulation of the genetic material of organisms, it has the possible risks of genetic contamination/inbreeding, competition with natural species, ecosystem damage, risk of horizontal gene transfer, new kinds of outbreak diseases; creation of drug resistant germs; accidental escape of laboratory strains and increased disease burden if the recipient organism is a pathogenic microorganism or virus. Additionally, now, scientists are faced with ethical issue challenges related to moral and religious acceptance and animal welfare.

Conclusion. Scientists need to consider the types of applications of genetic engineering which will appear on the commercial market as well as develop procedures which will minimize potential biological and ecological hazards of the technology. Even though, genetically modified foods currently available on the international market have passed safety assessments, countries vary in their regulation of genetically modified foods indicating the necessity of worldwide consensus on labelling and traceability of genetically modified foods taking into account health and environmental risks as well as religious issues.

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INTRODUCTION

Biotechnology, specifically genetic engineering is already a beneficial resource, employed in medicine, manufacturing, and agriculture. It has been started reaping the practical rewards of genetic engineering such as new medical therapies and increased agricultural yields [1].

There are many arguments in favor of the use of genetic engineering in the future. Among these are the promises that genetic engineering will feed the world, produce better crops, and be altogether good for the economy. Many different organisms are being used in today's genetic engineering research and development, including plants, trees, animals, insects, bacteria and viruses. In the agricultural sector, plants and crops are engineered to express a resistance to herbicides and specific pests. Scientists promise that genetically modified plants will have better texture, more flavor, and higher nutritional value than wild varieties of the same crops [2]. Farm animals are also modified to increase productivity and reduce costs for farmers. Pigs are engineered to have less fat, fish are being modified to grow larger more rapidly [3] and other animals are being engineered to increase productivity [4].

Although the benefits of genetically modifying organisms may seem vast, it is important to consider the fact that this is a very new technique and the risks involved are not fully understood [5]. The test subjects are living organisms, capable of growing, reproducing, migrating and interacting with other living organisms. This means that the risks involved with genetic engineering are inherently more dangerous and unpredictable than experiments using chemicals. Because of the unpredictable nature of living organisms, once a Genetically Modified Organisms (GMO) has been released into the environment, it is impossible to recall it [6]. Significant religious, secular and ethical implications ought to be taken into account as we go forward with genetic

engineering. Genetic engineering is seen by many people as 'playing God' [4] or putting people in the place of the Creator [6] as it gives to a few people the ability to change the natural world completely. By genetically modifying organisms, a scientist assumes that this extremely new science is better for populating the world than God or any other Creator, including natural evolution and natural selection. Religious groups may have specific reasons for objecting to GMOs. For example, Holy Bible [7] at Deuteronomy (አሪጉ ዘዳግም) 14:8 says 'And the swine, because it divides the hoof, yet cheweth not the cud, it is unclean unto you: You shall not eat of their flesh nor touch their dead carcass' and The Quran also prohibits the consumption of pork in many verses including: 2:173, 5:3, 6:145 and 16:115. If the modified products are not clearly labeled as containing pig genes, vegetarians would surely object to animal genes being inserted in fruits and vegetables [2].

Therefore, the objective of this review is to address some major benefits, risks and consumers' attitude towards GMOs.

DISCUSSION

Benefits of application of genetic engineering

Genetic engineering is relatively a new laboratory technique used by scientists to change the DNA of living organism. It has already supplied us with products that alleviate illness, clean up the environment, and increased crop and livestock yields. It also helped to create thousands of organisms and processes useful in medicine, research, and manufacturing. Genetically engineered bacteria churn out insulin for treating human diabetes, production of which would be substantially more expensive without the use of genetic engineering [8].

The number of organisms used in genetic engineering research is steadily increasing, as is the number of types of animals being used in the research. Genetically engineered organisms are used in many different sectors today, including agriculture, biomedical research, and animal farming. Farm animals are modified to increase productivity and reduce costs for farmers. Pigs are engineered to have less fat, fish are being modified to grow larger more rapidly [9]. Genetic engineering holds the promise of creating new, more productive strains of farm animals for meat and milk production. These new strains may be more resistant to infections, reducing the need for large, unhealthy doses of antibiotics. They may also be engineered to produce more meat, so we need not slaughter as many animals, or they may produce milk or other products with vital nutrients otherwise not found in those products, ensuring a healthier source of such nutrients [10].

Risks of application of genetic engineering

Since the technology plays with living organisms, interacting with other living organisms the risks involved are inherently more dangerous and unpredictable than experiments using chemicals. Because of the unpredictable nature of living organisms, once a GMO has been released into the environment, it is impossible to control [11]. Genetically modified organisms are living organisms and therefore, unlike chemicals that may become diluted, GMOs have the potential to disperse to new habitats, colonize those sites, and multiply. Their novel activities, including the production of metabolic products, enzymes and toxins will occur as long as the GMOs remain metabolically active. Once established, living organisms cannot be recalled [12].

One risk associated with genetic engineering is that it is based on the idea that each trait of an organism is encoded in a single, specific gene, and that the transfer of that specific gene will also cause the transfer of the sought-after attribute. However, genes cannot be regarded as separate entities. They are all related, and they are all influenced by many factors including the external environment [13]. This means that even though a gene may be related to a specific characteristic in one organism, it may not produce the same trait in another species or even in another organism of the same species. Therefore, it is almost impossible to predict the effect that transferring a specific gene will have on the individual to which it is transferred.

a) Risks to biodiversity

The introduction of genetically modified plants into the environment may have devastating effects on biodiversity. Birds, insects, and other animals that are dependent on certain crops for survival may find themselves unable to eat the genetically engineered crops due to the introduced gene or modification [9]. They may be allergic to the new traits, or find them poisonous. Therefore, these animals would have to find other sources of food, or face starvation. This would impact the entire food chain and the predator-prey relationships. The introduction of a modified organism into the environment may cause the displacement of indigenous fauna and flora [14]. If the new strain is superior to the parent strain, it may take over the habitat or eliminate the wild

strain. Also, any change in animal behavior could affect the entire food chain as well as predator-prey relationships [15].

b) Risks of genetically modified foods

Since the reason behind genetic engineering is basically to improve the quality of human lives, it is important to discuss the potential adverse effects that genetic engineering may have on human beings. Genetic material can enter the human body through food, bacteria, viruses, vaccines and medications. Most GMO sourced foods have a marker gene inserted in them along with the gene representing the desired trait [16]. According to these authors, if the marker genes were transferred successfully, the organism will exhibit a new resistance to particular antibiotics. Problems could arise for humans who eat food with these genes in them, particularly if they are unaware of the presence of the genes [17]. The antibiotic resistance gene could reduce the effectiveness of any antibiotics that the person happens to be taking at the time they are eating the product. Also, if people are constantly eating food with antibiotic resistance genes in them, they could develop a resistance to antibiotics as well. There is a risk that the nutritional quality of genetically modified food will be lower than that of unmodified foods [18].

In addition to the potential problems caused by marker genes and decreasing nutritional quality, genetically modified organisms may cause allergies in many people [19]. If people are not fully aware of the nature of the food that they are eating, they may consume substances which are harmful to them. Even if a person knows that s/he should avoid a specific substance, he may not be aware that the insertion of a new gene into the product has caused the expression of a similar substance. For example, people would not expect meat genes to be inserted into tomato. If a person were allergic to meat, he may also be allergic to the tomato, without realizing that it is the same substance causing the allergic reaction. For this reason, it is important that genetically modified foods be clearly labeled.

Concerns about eating GMOs can also arise for religious reasons. According to Chaudry and Regenstein [20], some of the potential controversies that consuming such foods would create for religious persons who observe dietary laws. Jewish law (*Halacha*) accepts genetic engineering to increase the quality or quantity of the world's food supply. But within the Muslim world no need for genetic modification of food crops because God created everything perfectly and man does not have any right to manipulate anything that God has created using His divine wisdom. Whereas in Christianity, no overarching consensus on the permissibility of GM technology, performing of GM research, or consumption of GM foods.

Consumers' attitude to GMOs

Despite the potential benefits there is a sizeable consumer opposition to genetically modified foods and other biotechnologies. Public attitudes to the biotechnologies are related to risk. It would be comforting to think that views were made on rational evaluation of the science, but usually they are made on values and emotion. A survey of attitudes in United Kingdom (UK) to genetic modification of foods found 70% of those questioned thought it was morally wrong. The figure was somewhat less in a United States (US) survey (45%). However, with greater exposure of the topic in recent years, public concern seems to have increased more [21].

According to the survey conducted by Biotechnology and the European Public Concerted Action Group [22], over 16,000 people in the European Union for their opinions about the use of biotechnology for genetic testing, production of medicines and vaccines, increasing crop pest resistance, food production, developing genetically modified animals for ethics, transgenesis and xenotransplantation. Although all of these applications of biotechnology were thought to be useful, the last three, which involve genetic manipulation of animals, were viewed negatively. Perception of risk appeared to play relatively little role in this judgment, except in the case of food production. What was most important was whether or not the application of the technology was felt to be morally acceptable. The committee that interpreted the survey concluded that the results indicated that perceived usefulness was a precondition for support and that people were prepared to accept some risks for those benefits, but that moral doubts acted as a veto irrespective of views on risks and benefits.

According to Sandoe and Holtung [23], similar views were aired at a consensus conference held in Copenhagen in 1992. The welfare of genetically engineered animals was a major concern of the participants, but they also thought it morally unacceptable to induce genetic changes in animals in order to adjust the animals to existing agricultural methods or to produce cheaper food. Likewise, Hoban and Kendall [24] surveyed approximately 1300 adults in the USA followed by focus group discussions revealed that, while most believed

that biotechnology would be personally beneficial to them, 53% also believed that it was morally wrong to use biotechnology to change animals, while only 24% believed that changing plants was wrong. The least acceptable applications of biotechnology were those that changed the composition of meat or milk, or increased animal growth rates. In the focus groups, women were particularly concerned about the humane treatment of animals and animal welfare issues arising from biotechnology.

Ethical concern in genetic engineering

Genetic engineering of a living organism may for a variety of reasons be thought of as being morally problematic in itself, i.e. due to its mode of production or to its source of genetic material be perceived as wrong or morally at least dubious. But genetic engineering may also be thought of as morally problematic because of its consequences. Kaiser [25] argued that all variants of intrinsic arguments against animal biotechnology could be summarized in the following claim: *It is unnatural to genetically engineer plants, animals and foods*. The commonly most well-known argument of this sort is the so-called "Playing God-argument" [26]. The basic assumption of the argument is the following: God has drawn up invisible boundaries between the realm of God and the realm of humans. Those that transcend this boundary are guilty of hubris, i.e. excessive pride. Obviously, any such argument would also be dependent on the more specific assumptions of a religion concerning the relation of God, humans and animals. The problem is to know where this boundary is. One version of the Playing God-argument holds that it is morally wrong to break down naturally occurring boundaries between different species, and another holds that it is morally wrong to modify living nature [27].

As stated by Partridge [28] also stated that, environmental ethics is concerned with responsible personal conduct towards the environment, natural landscapes, natural resources, and all species and nonhuman organisms. According to this author, it is important to keep environmental ethics in mind when discussing genetic engineering, as many of the arguments against genetic engineering have to do with whether it is 'right' to modify organisms and the natural environment.

Animal welfare in genetic engineering

Many groups have objections to the use of animals in scientific testing. They recognize that animals have interests, and that these interests should not be violated. One argument for why animals have interests is because they have the ability to suffer [29], but wonder if animal rights should be protected at the expense of human rights [4]. As noted by Canadian Environment Network [30], "Every life form is unique, and has intrinsic value regardless of any perceived value that it may have for humans". This means that animals and plants are significant in themselves and should be treated as ends in themselves, rather than simply a means to a human end.

In Europe, the UK report on animal welfare from 1965 that became known as the Brambell report, was highly influential. Well-known "five animal freedoms" included in Brambell committee [31] are:

- Freedom from hunger and thirst by ready access to fresh water and a diet to maintain full health and vigor.
- Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area.
- Freedom from pain, injury or disease by prevention or rapid diagnosis and treatment
- Freedom to express normal behavior by providing sufficient space, proper facilities and company of the animal's own kind.
- Freedom from fear and distress by ensuring conditions and treatment which avoid mental suffering.

Objections to genetic engineering

Some people object to any tinkering with the genetic codes of humans, or even of any life form. Some religious critics perceive genetic engineering as "playing God" and object to it on the grounds that life is sacred and ought not to be altered by human intention. Other objectors argue from secular principles, such as the outspoken and ardent Jeremy Rifkin, who claims that it violates the inherent "dignity" of humans and other life-forms to alter their DNA under any circumstances [32]. These arguments, while perhaps well-meaning, are not supported by sound logic or empirical evidence, as will be demonstrated in Epstein [33]. Religious objections assume the existence of some creator whose will is defined by genetic engineering, and secular objections assume that life in its "natural" state, unaltered by human intention, is inviolable because of its inherent dignity.

Religious objections to genetic engineering

Genetic engineering is seen by many people as putting people in the place of the Creator as it gives to a few people the ability to change the natural world completely. Some people hold that it is ethically questionable to transfer genes from one species to another species. This attitude is sometimes grounded in a religious belief that it is not up to humankind to violate boundaries that are set by God. Any design of nature through the insertion of new genes is, according to this argument, morally unacceptable. The argument does not occur in the Bible (in fact one may cite places to the opposite), but is based on an interpretation of God's will [20].

Secular objections to genetic engineering

Secular objectors to genetic engineering must defend the claim that the dignity of an individual member of a species, or of the species itself, is tied to its unhampered evolution to its present state [34]. Nature itself is indifferent to our dignity, and so altering nature cannot violate our dignity. In fact, it dignifies us to use the talents we have to alter our environment and our biology to improve our lives and those of the disabled. Technology in any form is an Outgrowth of our intellectual abilities: at its best, it allows us to overcome natural shortcomings. Home heating and air conditioning violate the natural order, yet allow us to thrive in climates we otherwise could not survive. Few would argue that overcoming that natural disadvantage violates our inherent dignity.

Those who argue for drawing a line at altering the genome of humans or other organisms must give reasons both for regarding DNA as somehow special and apart from the rest of the natural world and for arguing that conscious manipulation of DNA is morally impermissible. There are some reasons to support "genetic exceptionalism," the point of view that DNA is unique, but those arguments do not necessarily imply: a) that because of this uniqueness there are absolute bars to altering it; or b) that if it is acceptable to alter the DNA of non-humans, it is nonetheless unacceptable to alter that of humans. Uniqueness does not itself imply any moral duty. In fact, every human being is "unique" by virtue of DNA, environment, and upbringing, but our moral duties toward each do not depend upon that uniqueness. Neither of the assumptions above can be sustained by logic or empirical evidence and as indicated previously, we have been tinkering with genes in plants, animals, and even human beings, through selective breeding for millennia. Thus, the uniqueness of DNA has never forbidden us implicitly or explicitly to modify what we encounter in nature [35]. It is arguably just a matter of degree rather than a qualitative difference in kind that separates selective breeding and genetic engineering. Those who oppose genetic engineering on moral grounds must make a coherent case that it is qualitatively different from selective breeding, or they must similarly oppose the selective breeding which has resulted in almost every aspect of our modern agriculture.

Rawls [36] interprets human dignity as implying that we enter into a social contract treating each individual from the position of equality: "for in this situation men have equal representation as moral persons who regard themselves as ends and the principles they accept will be rationally designed to protect the claims of their person". We have dignity in a way in which no other animal does, which is not to say that other animals lack dignity. (Creatures have their own dignity, inherent to their species and capacities).

We are the only creatures we know capable of art, science, literature, architecture, and transforming our environment to accommodate our physical limitations. The concept of human dignity is perfectly compatible with genetic engineering. Recognizing human dignity often means taking steps to ensure that where nature impedes human potential, everyone's human potential may be achieved to the fullest. The disabled and the infirm should be aided wherever possible, and consistent with their stated goals, to achieve their potential, consistent with the principle of avoiding harm to others. Indeed, recognizing the inherent dignity of our fellow human beings suggests that we are impelled to pursue genetic engineering research, to the degree that it can help to develop therapies and treatments for those who suffer or develop natural or accidental limitations [37].

Clearly, some limits on genetic engineering also may be required by human dignity. Actions that diminish the capacities of others to achieve their potential are affronts to human dignity. Genetic engineering requires special attention to issues of equal access and even some restrictions on its applications where they may threaten subordination of some humans. Any invention used to diminish critical human capacities, such as cognitive functioning, would be unethical. Thus, while some people might benefit from a small race of humans genetically engineered to be slaves with diminished mental capacities this would clearly and egregiously violate human dignity [38].

CONCLUSION

Agriculture and medical industry are two major applications of genetic engineering. Agriculture particularly modifying plant varieties greatly benefits from genetic engineering. Though the slogan of genetic engineering is 'feeding the world and sustainability', there are many arguments in favor use of genetic engineering in the future. Consumers have raised a series of concerns and uncertainties with regard to human health, environment, and animal welfare, moral and religious acceptances. Since genetic engineering risks involved are not well understood. The risks related to the GMOs should be studied in detail and accessed by the public. Governments in all countries should have regulations on safety issues, labelling and traceability of GMOs.

DECLARATIONS

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Authors' contributions

H.Gatew designed the general concept and wrote the manuscript. K.Mengistu reviewed and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

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In vitro nematicidal activity of Juglone against *Meloidogyne incognita* race 2 infesting pomegranate

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ABSTRACT

Introduction. *Juglans regia* L. (walnut) is also known as the medicinal plant and native to the mountain ranges of central Asia. Recently, a severe infestation of root-knot nematodes (RKN, identified as *Meloidogyne incognita* race 2), was observed on *Punica granatum* L. (pomegranate). **Aim.** The present study aimed to investigate the effect of in-vitro nematicidal activity of the purified bioactive compounds (Juglone: 5-Hydroxy 1, 4-Napthoquinone) isolated from medicinal plant like walnut on *Meloidogyne* species associated with pomegranate under field conditions. **Methods.** Plants are cultivated at the agricultural farm in Solapur, (M.S.), India. **Results.** Roots of infected plants were heavily galled and soil samples collected from the affected plants second stage juveniles (J2). The ability of treatment schedule of Juglone was tested using an in-vitro method against RKN - *Meloidogyne incognita* race 2 infesting pomegranate. Juveniles in the control (distilled water; carbofuran) were compared with treated groups. The Juglone showed a 100% mortality in 5 µl/ 10 ml of distilled water/ 100 nematodes.

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INTRODUCTION

Pomegranate (*Punica granatum* L.) is an important fruit crop of India. Pomegranate is delicious, popular fruit in India and several other countries of the world. It is the natural food for man. It is excellent source of vitamins, minerals, and enzymes. All parts of the fruit, seed, rind, and membrane have been shown to have potential health benefits. One of the most studied constituent of pomegranates is a polyphenol calls ellagitannins and ellagic acid [1].

Nematodes associated with pomegranate trees causes' severe damage to whole thickness of the root and stunting. Lesions were formed at the site of entry with necrosis, enlargement of cells into giant cells, containing egg masses and sections of larvae [2].

There are different pest attacks on the pomegranate plants by bacteria, virus fungal, but plant parasitic nematode is one of the major yield limiting factors. Now the productivity of pomegranate in Maharashtra is highest in the country [3, 4]. Further, *Meloidogyne incognita* L. has been observed as a serious problem on pomegranate in Maharashtra and attributed 32% yield losses in the identified hotspots. In the present study, in vitro nematicidal activity of Juglone as bioactive compound was evaluated on root-knot nematodes collected from pomegranate. Juglone, also called 5-hydroxy-1,4-naphthalenedione (IUPAC) or 5-hydroxynapthoquinone, is an organic compound with the molecular formula $C_{10}H_6O_3$. In the food industry, Juglone is also known as C.I. Natural Brown 7 and C.I. 75500; with systematic name: 5-Hydroxy-1,4-napthoquinone.

MATERIAL AND METHODS

Preparation of plant extracts

Juglone, extracted by using polar and non-polar chemicals by cold extraction method; extract will be separated by using Column chromatography and tested by spectroscopy as follows: IR = Perkin-Elmer 599-B in $CHCl_3$; NMR = 200 MHz Bruker Ac 200 MHz in $CDCl_3$; Mass Spectra, Finnigan Mat 1020 using direct inlet system at 70 V; For purity and structure determination of the pure molecules Juglone = 5-Hydroxy 1, 4-Napthoquinone.

Collection of root samples

Pomegranate (*P. granatum* L.) root samples with soil were collected from the field located in Solapur district, Maharashtra state, India. Two hundred grams of soil and roots from each sample were processed for the isolation of nematodes.

Cobb's decanting and sieving method for collection of nematodes

Nematodes were extracted by Cobb's decanting and sieving methods [4]. Direct contact toxicity of compound at different dose was analyzed by exposing freshly hatched J₂ and J₃ of *Meloidogyne* species [5].

In vitro phyto-nematicidal activity

For in vitro nematocidal activity, the method described by Dama [6] and Dama et al. [7]. used for present study. The test animals are divided in 5 groups in which one distilled water and one for slandered carbofuran chemical, each group contains 100 phyto-nematodes, with test compound concentration of 1 µl to 5µl.

The observations were taken at 24 hrs after exposure of test compounds under compound and stereomicroscope, on Juvenile mortality was recorded and expressed as percentage of efficacy against *Meloidogyne* species in each group were estimated by statistical analysis on the basis of the arithmetic mean number of J₂ recovered. Juveniles in the control (distilled water; carbofuran), and also treated groups were compared statistically.

Statistical analysis

For taxonomic identification, the generated data was compared with taxonomic aids. Rate of immobility (i) was calculated and the obtained data analyzed by using Standard statistical methods (like SAS method). Standard deviation or confidence intervals of the means of LC₅₀ values are calculated and recorded. Formula for percentage of mortality is as follows:

$$\text{Percentage of mortality} = \frac{\text{Number of dead larvae}}{\text{Number of larvae introduced}} \times 100$$

RESULTS AND DISCUSSION

The Results are shown in table 1 and figures 1-6. The action of Juglone on *Meloidogyne* species associated with Pomegranate roots, demonstrated maximal activity. The spectral data of Juglone where shown in figure 1.

The spectral data analysis of Juglone are as follows: IR= CHCl₃ : 3300, 1730, 1430 cm⁻¹; NMR= 1H mr (200 MHz); CDCl₃ : 6: 92 s(2H); 7.30m (1H) and 7.72m (2H). 11.9 (s, ¹H, OH, D₂O exchange); Mass Spectra 174.

The results of spectral data namely IR, NMR and Mass Spectra showed the isolated pure bioactive compound as Juglone. Figure 2 shows the *Juglans regia* tree with green walnuts. *Punica granatum* L., the healthy plant, infected plant and infected roots were shown in figure 3. Figure 4 showed the extraction of plant paparasitic nematode by using Cobb's decanting and sieving method for collection of Nematode.

Phyto-nematicidal activity of Juglone on the mortality (immobilized nematodes) of root-knot nematode *Meloidogyne* sp. in 24 hrs were shown in table 1 and figure 6. The results compared with the available observations pointed out by Shelke and Darekar [8] and Pawar et al. [3]. Although, observations suggested that Juglone was active compound which require future pharmacological and toxicological studies prior to their use in the integrated diseases management (IDM) of plant parasitic nematodes. The result indicated that Juglone was very effective to controlling *Meloidogyne* species 100% mortality in 5 µl.

The present work confirms that the effect of Juglone shows the phyto-nematicidal activity on *M. incognita* race II associated with Pomegranate at very low concentration. The uses of bioactive compounds are an interesting option to control the root-knot nematodes instead of the chemical control and have no effect on human health. There was no any reported information on the effect of Juglone on plant-parasitic nematode *M. incognita* race 2 infecting pomegranate. The seasonal incidence and biological management of root-knot nematode, *Meloidogyne incognita* [9], the infesting pomegranate, *Punica granatum* observed by Walunj [10].

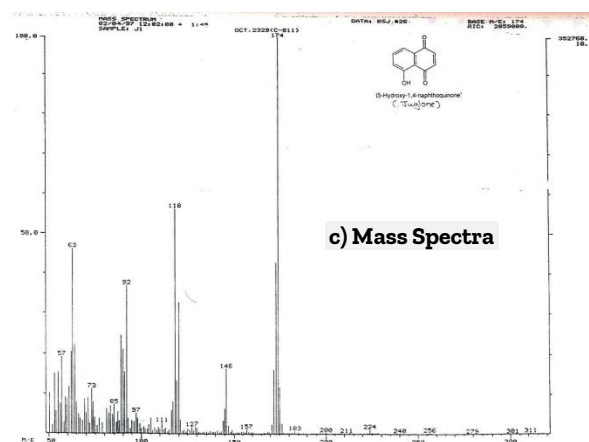
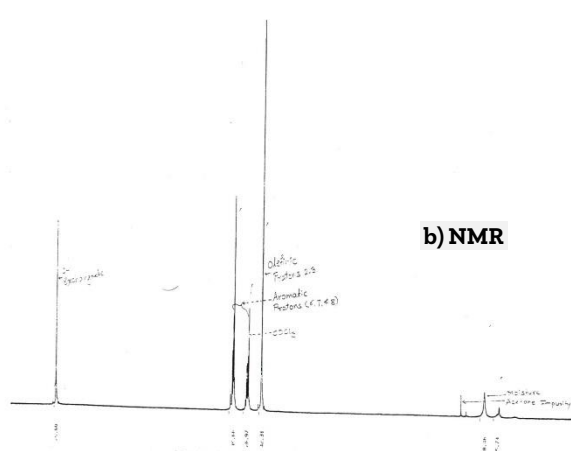
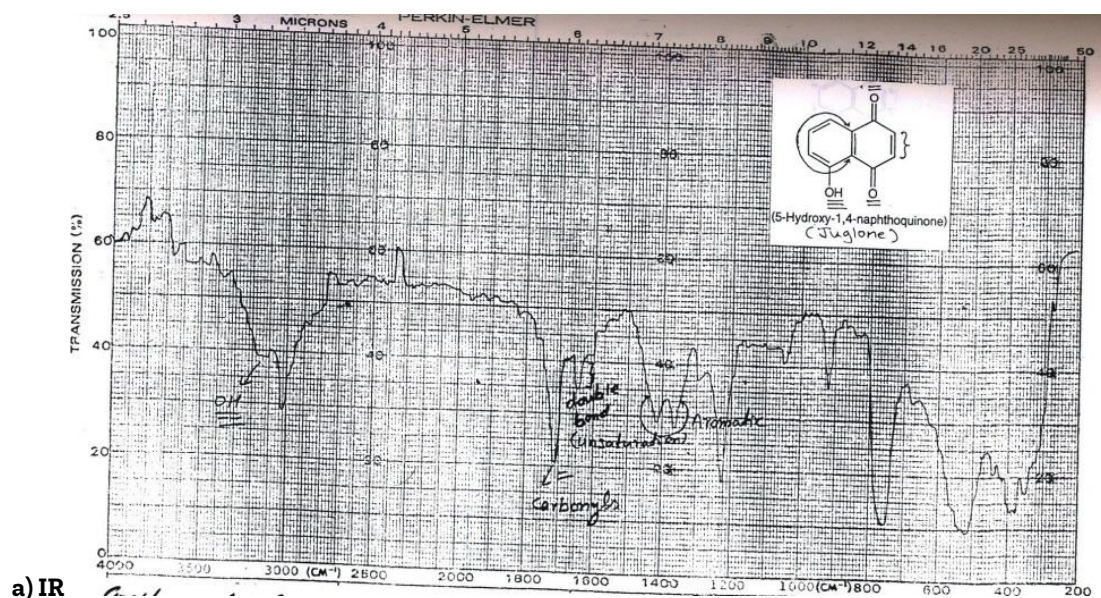


Figure 1. Spectra of Juglone. a) IR; b) NMR; c) Mass Spectra

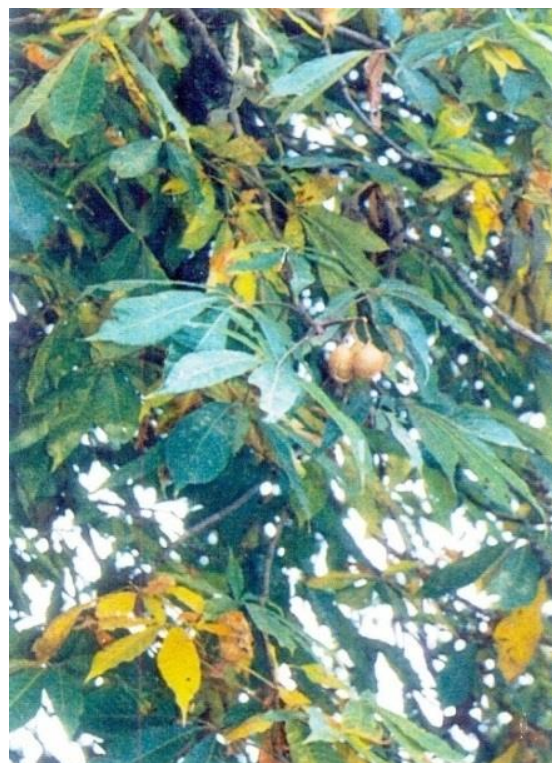


Figure 2. *Juglans regia* tree shows green walnuts

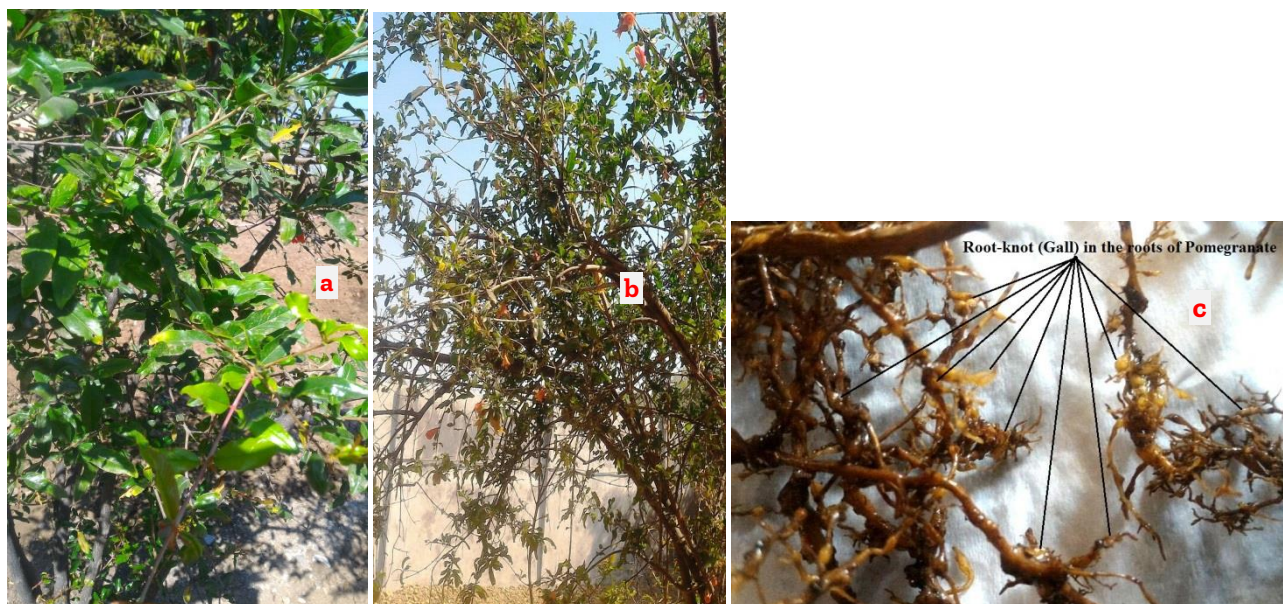


Figure 3. *Punica granatum* L.; a) healthy plant, b) infected plant, c) infected roots (root-knots of *Meloidogyne* spp.)



Figure 4. Cobb's decanting and sieving method for collection of nematodes.



Figure 5. *Meloidogyne* sp. isolated from the soil and roots from *Punica granatum* L., (Root-knot nematodes- *M. incognita* race 2, magnification 10x × 45x); a) Juveniles, b) Female, c) Nematode entering in the pomegranate root

Table 1. Phytonematicidal activity of Juglone on the mortality (Immobilized Nematodes) of root-knot nematode *Meloidogyne* sp. in 24 hrs

Concentration of Juglone / 10 ml of D.W.	1 μ l	2 μ l	3 μ l	4 μ l	5 μ l
No. of root-knot Nematodes	100	100	100	100	100
Juglone	60	74	84	92	100
Distilled water	00	00	00	00	00
Carbofuran	80	85	96	100	100

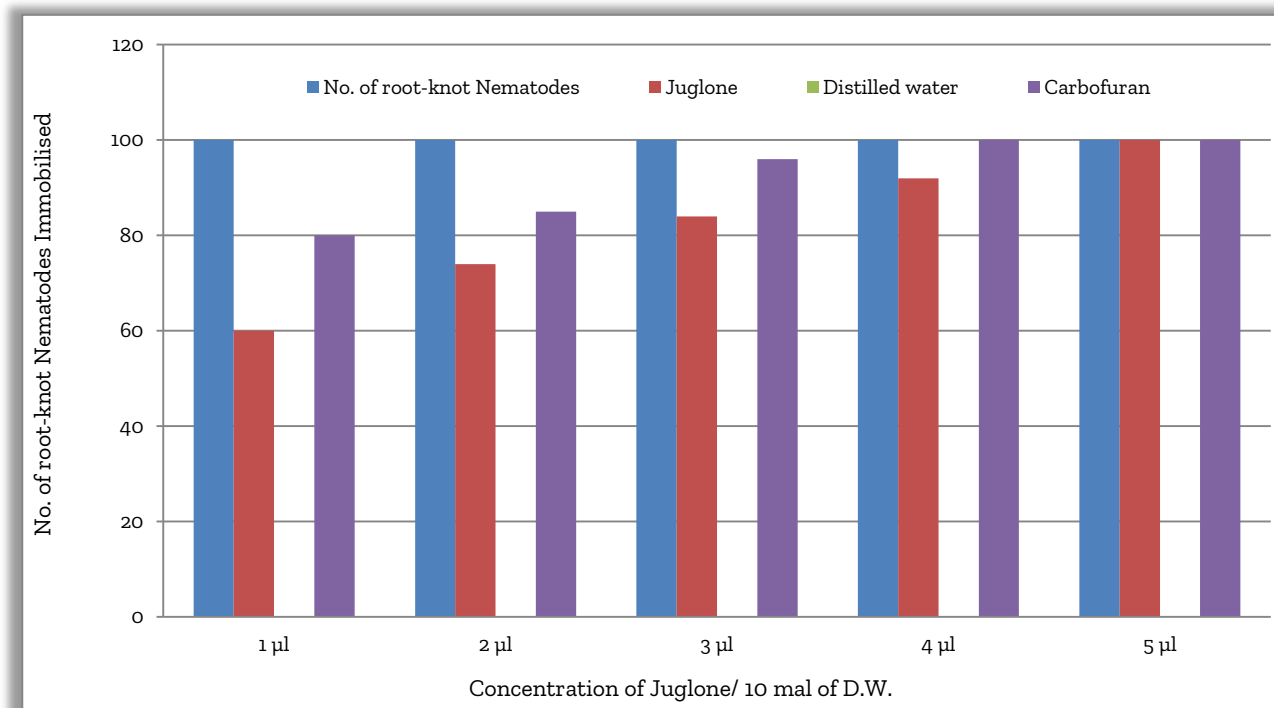


Figure 6. Phyto-nematicidal activity of Juglone on the mortality (immobilized nematodes) of RKN nematode *Meloidogyne* spp. in 24 hrs.

CONCLUSION

Juglone is highly active phyto-nematicide as compared to control and other phyto-nematicide. Improved data management and decision-support systems should facilitate the integration of new and traditional IPM strategies and tactics. In conclusion the naphthoquinones are highly active against in controlling plant parasitic nematodes namely *Meloidogyne* Sp. To reduce the cost for collecting the naphthoquinones from various plant other raw materials like, Tendu leaves, *Plumbago zylanica* and leaves of *Lawsonia innermis* need to be further carried out. This research work findings are useful for plant pathologists, teachers, agriculturist, students, farmers and research workers in this field of study.

DECLARATIONS

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Authors' contributions

All authors contributed equally to this work.

Competing interests

The authors declare that they have no competing interests.

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Ethnogeographic features of nutrition as a key factor in the development of iron deficiency anemia in the Bukhara region

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ABSTRACT

Introduction. Ecological disasters, industrial pollution, and poor nutrition lead to significant changes in the content of microelements (MEs) in food and, as a consequence, in the human body, while toxic MEs accumulate, displacing essential ones. Iron deficiency anemia refers to biogeochemical poly-microelementosis. For the prevention and treatment of iron deficiency anemia (IDA), drugs containing microelements are used along with traditional methods of treatment. **Aim.** This study aimed to investigate the nutritional characteristics and the ME content in the diet in order to clarify the etiology of IDA, the role of microelementosis in its development, and to also identify indicators of red blood parameters in families living in the Qorovulbozor district of the Bukhara region. **Methods.** Ten families were examined, each consisting of a husband, a wife, and female children. In order to facilitate the analysis of the results obtained, the husbands and wives selected for examination from those were aged between 30 and 45 with daughters from 12-17 years old. The content of MEs in erythrocytes and blood serum, in tap water, and in irrigation ditch (arch) water was determined. **Results.** A relatively favorable picture was observed only in men, while 1-3 degree IDA was observed with almost the same frequency in both mothers (75-78.5%) and their daughters (20-21.4%), respectively. Daily nutrition was roughly estimated by dividing the volume of food consumed per week into 7 days and the number of family members. Despite this, iron deficiency turned out to be significant for such products as meat, milk, bread, eggs, and fruit. This served as the basis for convincing the subjects of the need for proper nutrition and the administration of ME containing preparations (Vitrum Prenatal Forte). **Conclusion.** In order to exclude the entry of toxic MEs into the body, it is advisable to use mineral water for food, especially during pregnancy, instead of tap water. Our findings provide the basis for the need to correct the ME composition of the body with the necessary MEs, not only by increasing the volume and quality of food products, but also by using medications containing MEs.

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INTRODUCTION

According to the researchers, various etiological factors cause iron deficiency anemia (IDA) [1, 2]. Anemia can occur in an environmentally disadvantaged region, on the basis of increased consumption of microelements, impaired iron resorption in the gastrointestinal tract, due to a lack of exogenous MEs, including iron [3, 4].

Environmental disasters, man-made pollution, and improper nutrition lead to significant changes in the ME content in the human body, at the same time toxic MEs accumulate, displacing essential MEs [5]. The level of MEs and their relationship in the body organs depend on the degree of blood supply, peculiarities of functional activity and available pathologies. Thus, loss of iron in the blood is one of the most common causes of anemic conditions. Iron deficiency anemia refers to polymicroelementoses (pathological processes caused by deficiency, excess and imbalance of microelements in the body) of biogeochemical nature. Along with traditional methods of treatment, ME-containing medications are used to prevent and treat IDA [6, 7].

It is known that certain regions have their own specifics for the ME content that distinguishes them from others [8]. Hence the traditional approach to the prevention and treatment of IDA is not justified. Literature data indicates the need to develop ME-containing preparations for certain regions based on the ME content in the air, soil and water [9]. This research is devoted to the study of ME blood composition in families living in the Qorovulbozor district of the Bukhara region, where a large oil refinery is located, which has a technogenic impact on the region. In addition, families' food rations were first studied with an estimate of the ME intake. The data obtained will help to clarify the pathogenesis of IDA development in adolescent girls from the perspective of microelementosis and to develop a reasonable set of therapeutic and preventive measures.

The research is aimed at studying the nutritional characteristics, the content of microelements in the food rations in order to clarify the IDA etiology and the role of microelementosis in IDA development by investigating red blood cell parameters in families living in the Qorovulbozor district of the Bukhara region.

MATERIAL AND METHODS

Examinations covered ten families, each consisting of a husband, wife, and female children. In order to facilitate the analysis of the results obtained, parents aged between 30-45 were selected for the research, with their daughters aged between 12 and 17. We studied their medical background, previous diseases that can affect the ME composition of blood, Hb concentration, RBC count, blood color index and ESR results. Families were identical in terms of social background – employees and workers, as well as in medical background and previous diseases. Family members with acute inflammatory diseases or disease recurrences were excluded from the analysis. The content of ME was determined in erythrocytes and blood serum, in tap water, and in irrigation ditch (arch) water. Since the main source of ME supply in the human body is food, we studied daily food rations in families and calculated the daily ME requirement depending on the food assortment. The standard indicators of the ME content in 100 g of the product were the basis for comparison [10]. Following the results of this analysis, we made recommendations for proper nutrition and prescribed *Vitrum* preparations containing microelements.

Statistical analysis

The data obtained during the study was subjected to statistical processing on a Pentium-V personal computer using the Microsoft Office Excel-2003 software package, including the use of built-in statistical processing functions. We used methods of variational parametric and nonparametric statistics with calculation of the arithmetic mean of the studied indicator (M), standard deviation, standard error of the mean (m), relative values (frequency, %), the statistical significance of the measurements obtained when comparing the average values was determined by the criterion Student (t) with the calculation of the probability of error (P) when checking the normality of the distribution (by the excess measure) and the equality of the general variances (F - Fisher's test). For statistically significant changes, a confidence level of $P < 0.05$ was taken

Ethical approval

The review board and ethics committee of Tashkent Pediatric Medical Institute approved the study protocol and informed consents were taken from all the participants.

RESULTS AND DISCUSSION

Table 1 presents the results of a general blood test in family members before and after treatment. As can be seen from the table, IDA of varying severity was found in the examined population. Thus, stage 1 of the IDA was not observed in girls, while stage 2 was observed in 78.5% and stage 3 was present in 21.4% of girls; in their mothers we observed stage 1 of the IDA in 5%, stage 2 in 75%, and stage 3 in 20% of subjects, respectively; in their fathers we evidenced stage 1 in 65%, stage 2 in 35% of men, respectively, while stage 3 was found in none of the subjects. Thus, a relatively favorable picture was observed only in men. Stage 2 and stage 3 of the IDA were observed with almost the same frequency in both mothers and their daughters: 75% (78.5%), and 20% (21.4%), respectively. Thus, IDA develops in children from an early age. The study of the food rations showed that in almost all families there is a shortage in the consumption of basic food products compared to the norm. This is confirmed by the presence of anemia in the male part of the examined subjects. The data on daily food requirement and actual consumption of food products in the studied families is given in Table 2. On short notice, it should be mentioned that the volume of consumption per week was roughly estimated and divided into 7 days and the number of family members. Despite this, the deficiency turned out to be significant for some products, such as meat, milk, bread, eggs, and fruit. This served as the basis for convincing the subjects of the need for proper nutrition and prescription of *Vitrum Prenatal Forte* preparations containing microelements.

Next, we studied the shortage of ME intake into the body with food based on the data obtained. Standard data on ME content in 100 grams of a product is given in Table 3 based on the indicators specified in [10].

When comparing the actual consumption of food products (14 basic ones) with the norms of consumption and the ME content in these food products, a significant shortage of both essential and conditionally essential MEs was found. Due to the fact that less food is consumed, fewer toxic MEs entered the body accordingly. The same can also be attributed to pregnant women, since their questioning gave the same results of ME consumption shortage. It is noteworthy that the water used in food contains toxic MEs such as Be, Cd, Hg, Al, and Pb. Normally, toxic microelements should not be found in water. The fact is that they have the ability to competitively bind to proteins, enzymes, and other vital substances and distort their function, displacing essential and conditionally essential microelements [11]. The foregoing is one of the reasons for the development of not only anemia, but also of other diseases present in the examined population.

Table 1. Red blood cell parameters in family members with complicated IDA

Parameter	Family with IDA, n=10					
	In daughters, n=10		In mothers, n=10		In fathers, n=10	
	Pretreatment parameters	Follow-up control	Pretreatment parameters	Follow-up control	Pretreatment parameters	Follow-up control
Hb, g/l	79.8±3.4**	114.5±3.6	81.8±3.5**	120.4±4.4	102.2±3.8**	130.2±4.6
RBC, 10 · 12 g/l	3.2±0.4*	3.6±0.6	3.3±0.2*	4.0±0.8	3.7±0.5*	4.6±1.0
Color index	0.8±0.03*	0.9±0.04	0.8±0.06*	0.9±0.1	0.9±0.08	0.9±0.2
ESR	4.0±1.1	4.2±1.2	4.8±1.4	5.7±2.5	4.2±1.3	4.3±2.2

Note: * P<0.05 and **P<0.01 compared to the parameters in males. IDA= iron deficiency anemia; Hb= hemoglobin; RBC= Red blood cell and ESR= erythrocyte sedimentation rate.

Table 2. The daily food requirement and actual consumption of food products in the examined families living in the Qorovulbozor district (Bukhara region, Uzbekistan)

Food products	Standard daily requirement	Food consumption in a family with IDA	Shortage in consumption of food products
Meat	150 g	90 g	60 g
Milk	500 ml	290 g	210 g
Rice	50 g	40 g	10 g
Bread	250-300 g	150 g	150 g
Chocolate	40 g	10 g	30 g
Eggs	1-2 (120 g)	60 g	60 g
Potato	100 g	100 g	0 g
Onion	150 g	100 g	50 g
Fruit	200-250 g	100 g	150 g
Cabbage	300-600 g	200 g	400 g
Carrot	50-100 g	80 g	20 g
Beet	100-150 g	50 g	100 g
Tomato	200-300 g	100 g	200 g
Honey	80-100 g	40 g	60 g

IDA= iron deficiency anemia

Table 3. Standard indicators of ME content in 100 g of a product [10]

ME	Essential microelements										Toxic microelements				
	Cr	Mn	Fe	Co	Cu	Zn	Se	Mo	I	Ni	Be	Al	Cd	Hg	Pb
Food products	Minerals in 100 g of a product														
Meat	8.7	35.0	2090	6.0	238	2820	-	9.0	2.7	5.5	-	-	-	-	-
Milk	2	6	67	0.8	12	400	2.0	5.0	9.0	-	-	50	-	-	-
Rice	2.8	3630	2090	6.9	560	1800	20.0	26.7	2.3	51.6	-	912	-	-	-
Beans	10.0	1340	5940	18.7	580	3210	24.9	39.4	12.1	173.2	-	640	-	-	-
Buckwheat	6.0	1760	8270	3.6	660	2770	-	38.5	5.1	-	-	-	-	-	-
Green peas	9.0	1750	6800	13.1	750	3180	13.1	84.2	5.1	246.6	-	1180	-	-	-
Onion	2	230	800	5	85	850	-	-	3.0	3.0	-	400	-	-	-
Bread	4.5	1470	3900	3.0	290	1850	-	20.4	-	20.0	-	1400	-	-	-
Potato	10	170	900	5	140	360	-	8.0	5.0	5.0	-	860	-	-	-
Aubergine	-	210	400	1	135	290	-	10.0	2.0	-	-	815	-	-	-
Cabbage	5	170	600	3	75	400	-	10.0	3.0	15.0	-	570	-	-	-
Tomato	5	140	900	6	110	200	-	7.0	2.0	13.0	-	-	-	-	-
Cucumber	6	180	600	1	100	215	-	1.0	3.0	-	-	425	-	-	-
Beet	20	660	1400	2	140	425	-	10.0	7.0	14.0	-	-	-	-	-
Carrot	3	200	700	2	80	400	-	20.0	5.0	6.0	-	323	-	-	-
Pumpkin	-	40	400	1	180	240	-	-	1.0	-	-	-	-	-	-
Chocolate	-	3100	5000	-	495	-	-	-	5.5	-	-	-	-	-	-
Honey	-	34	800	0.3	59	94	-	-	2.0	-	-	-	-	-	-
Kefir	2	6	80	1	10	400	2.0	5.0	9.0	-	-	-	-	-	-
Grapes	3	90	600	2	80	91	-	3.0	8.0	16.0	-	380	-	-	-
Eggs	4	29	2500	10	83	1110	-	6.0	20.0	-	-	-	-	-	-
Pear	-	65	2300	10	120	190	-	5.0	1.0	17.0	-	-	-	-	-
Plum	4	110	500	1	87	100	-	8.0	4.0	15.0	-	-	-	-	-
Melon	-	35	1000	2	47	90	-	-	2.0	-	-	-	-	-	-
Semolina	4.3	440	960	25	70	590	-	11.3	-	11.5	-	570	-	-	-
Peach	14	140	600	-	50	100	-	-	2.0	4.0	-	650	-	-	-
Fish	55	60	1000	20	60	450	-	4.0	5.0	6.0	-	-	-	-	-
Walnut	-	1900	2300	7.3	527	2570	-	-	3.1	-	-	-	-	-	-

ME= Microelements; Cr=Chrome; Mn=Manganese; Fe=Ferrum; Co=Cobalt; Cu=Cuprum; Zn=Zinc; Se=Selenium; Mo=Molybdenum; I=Iodine; Ni=Nickel; Be=Beryllium; Al=Aluminum; Cd=Cadmium; Hg=Mercury; Pb=Lead.

CONCLUSION

In order to exclude the entry of toxic ME into the human body, it is advisable to use mineral water for food, especially during pregnancy, instead of tap water. Our findings provide the basis for the need to correct the ME composition of the human body with the necessary MEs, not only by increasing the volume and quality of food products, but also by using medications containing MEs. This is evidenced by the indicators of ME blood composition, both in the studied families and in pregnant women.

DECLARATIONS

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Authors' contributions

All authors contributed equally to this work.

Competing interests

The authors declare that they have no competing interests.

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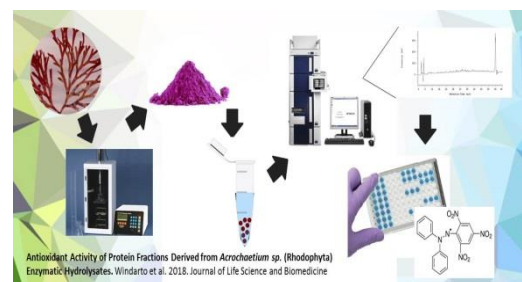
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1. Hasan V, Sri Widodo M and Semedi B. Oocyte diameter distribution and fecundity of Javaen Barb (*Systomus Orphoides*) at the start of rainy season in Lenteng River, East Java, Indonesia insurance. J. Life Sci Biomed, 2015; 5(2): 39-42. DOI, Link
2. Karen KS, Otto CM. 2007. Pregnancy in women with valvular heart disease. Heart. 2007 May; 93(5): 552-558. DOI, Link
3. Doll MA, Salazar-González RA, Bodduluri S, Hein DW. Arylamine N-acetyltransferase 2 genotype-dependent N-acetylation of isoniazid in cryopreserved human hepatocytes. Acta Pharm Sin B, 2017; 7(4):517-522. DOI, Link

For In press manuscripts (maximum 2):

Hasan V, Sri Widodo M and Semedi B. 2015. Oocyte Diameter Distribution and Fecundity of Javaen Barb (*Systomus Orphoides*) at the Start of Rainy Season in Lenteng River, East Java, Indonesia insurance. In press.

For symposia reports and abstracts:

Cruz EM, Almatar S, Aludul EK and Al-Yaqout A. 2000. Preliminary Studies on the Performance and Feeding Behaviour of Silver Pomfret (*Pampus argentens euphrasen*) Fingerlings fed with Commercial Feed and Reared in Fibreglass Tanks. Asian Fisheries Society Manila, Philippine 13: 191-199. DOI, Link

For Conference:

Skinner J, Fleener B and Rinchiuso M. 2003. Examining the Relationship between Supervisors and Subordinate Feeling of Empowerment with LMX as A Possible Moderator. 24th Annual Conference for Industrial Organizational Behavior. DOI, Link

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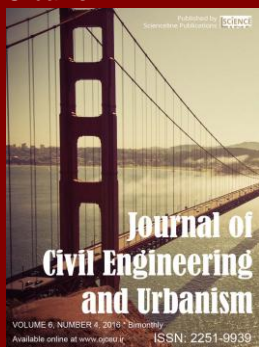
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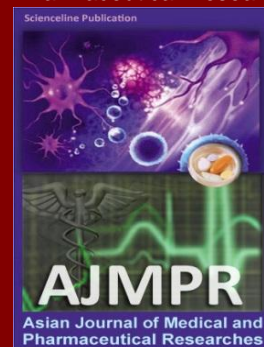
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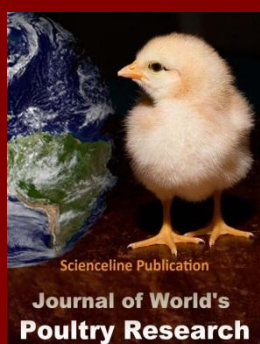
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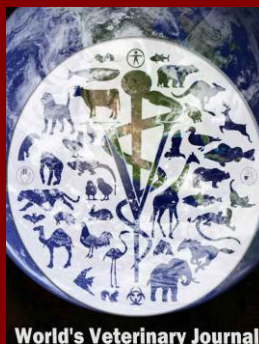
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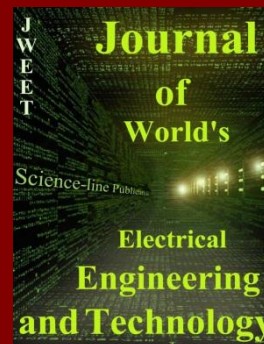
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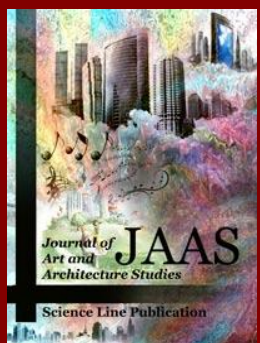
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