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Prof. Dr. Mustafa Şahin Dündar - TOJSAT, Editor Sakarya-Turkey

## Message from the Editor-in-Chief

**Dear Colleagues,**

TOJSAT welcomes you. TOJSAT would like to thank you for your online journal interest. The online journal system has been diffused very fast for last nine years. We are delighted that more than 200,000 educators, teachers, parents, and students from around the world have visited for nine years. It means that TOJSAT has continued to diffuse new trends in science and technology to all over the world since January, 2011. We hope that the volume 10, issue 1 will also successfully accomplish our global science and technology goal.

TOJSAT is confident that readers will learn and get different aspects on science and technology. Any views expressed in this publication are the views of the authors and are not the views of the Editor and TOJSAT.

TOJSAT thanks and appreciate the editorial board who have acted as reviewers for one or more submissions of this issue for their valuable contributions.

TOJSAT will organize ISTEC 2020 (International Science & Technology Conference) (www.iste-c.net) between July 02-03, 2020 in Rome, Italy. This conference is now a well-known science and technology event. It promotes the development and dissemination of theoretical knowledge, conceptual research, and professional knowledge through conference activities. Its focus is to create and disseminate knowledge about science and technology. ISTEC-2019 conference book has been published at **http://www.iste-c.net/istecpubs**

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TOJSAT invites you article contributions. Submitted articles should be about all aspects of science and technology. The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJSAT. Manuscripts must be submitted in English.

TOJSAT is guided by it's editors, guest editors and advisory boards. If you are interested in contributing to TOJSAT as an author, guest editor or reviewer, please send your cv to editor.

**January 01, 2020**
**Prof. Dr. Aytekin ISMAN**
**Sakarya University**

 

## Message from the Editor

Dear Readers,

Happy New Year.

Welcome to the 1st issue of 2020 of the online journal of science and technology. Papers were contributed from Poland to Turkey and include selected titles for instance the Effect of Hop A-Acids on the Alcoholic Fermentation Process and the Ethanol Yield; Determining Unnamed Aerial Vehicle Design Parameters for Air Pollution Detection System.

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**January 01, 2020**
**Prof. Dr. Mustafa S. DUNDAR**
**Sakarya University**

 

 

 

 

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# ABOVE SEMIOLOGY COMPARING AND CONTRASTING THE REFLECTIONS OF HOLLYWOOD ACTORS AND ACTRESSES ON YEŞİLÇAM ACTORS AND ACTRESSES IN THE 1950-1970 PERIOD

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**Abstract:** The aim of this article is to explain the effects of Hollywood actors and actresses on the structuring of Turkish cinema Yeşilçam period actors and actresses by using the data of semiotics. It covers the tone, body language and all visual elements. Such as Clark Gable look and his moustache, Kim Novak's posture, hair and his gaze at the camera.
**Keywords:** Semiotics, Clark Gable Look, Kim Novak, Moustache of Clark Gabel, Body Language,

## Introduction

The Western world met the ideology of capitalism after the 18th century enlightenment. The environment of the 18th century Enlightenment which valued to human and put it into the center and put emphasis on humanitarian values must not have satisfied the playmakers who wanted to make money without putting too much effort that, the foundation of the ideology of capitalism was formed. The answer to the question what were the reflections of the determinations in the nature saying "whoever fits he survives, natural selection" on the social life may be also the proliferation and deepening of capitalization. If the strong defeats and eats the weak in nature, and if it is only those who keep up with this system will have the chance to survive, then it is also the case for the human being. This is the law of jungle. In the current system, the one who can remain standing will survive. Yet we, as 'animals which can think and talk', could have also preferred to protect the weak, powerless, child, and old and also protect the animals that need help within the framework of all those universal human rights, push them up, save them and aggrandize them, this is a philosophy that has been existed in the Anatolian land at the same time, however, then, the others would not exist and it would not be possible to earn lots of money. The cinema industry is considered as a cruel world that has been established on such a system and which is prioritizing capital. The cinema industry is being considered as a cruel world that has been established on such a system and that is putting the money in the center and thinking about the capital in the first plan. This may have been the case, particularly for women. Because it is Hollywood that is being talked about, some differences have occurred between the American and the European cinemas starting from the first quarter of the 20th century. While American cinema focused on profitability as the main starting point, the Europeans have continued to improve the art of cinema in a people-oriented way.( moviesdatabase.weebly.com/tarih)

Some references were necessary to be put in the center of the profit-oriented cinema. Although the silent cinema periods must be studied in terms of 'fame' and 'celebrity' concepts, the following can be said from a birds-eye-view: In that period, fame was not a thing to be designed and sold. Charlie Chaplin may be a 'celebrity' created by himself: He had inborn acting talents and his intelligence was included in that. Maybe, that is why he could survive strongly among the gears of the period; at least without being ground…
Hollywood was sales-oriented and therefore impressing was the star. It was more like company management rather than a state founded around oil. The Hollywood movies were being marketed in a jaw-dropping way in the other countries of the world that were developing and were being avoided to develop. Top model Fords were being watched in admiration from all countries of the world. The state-of-the-art products to be put on the world market: Toasters, clothing for men and women,

Well, then, through whom could they realize all those sales? Why and how was the 'celebrity' concept fabricated in the first place? Did technology alone fail to direct people to purchase? Did they see it in a movie house, left it there and ran away? Perhaps it was scientific data that triggered the act of realizing sales through 'celebrity'. For people to interiorize something, they need to find it close to themselves or develop role models. And to some extent, it was necessary to idealize these people, so that the public could emulate and say that I also can possess everything that supreme existence (the perception created) has.… The first years of 'Perception is everything'. Perception is everything: Was it created for Hollywood? This article has brought along many topics to study and everything that was included in the content of this article as a question and a subject that could not be explained completely will be planned to be discussed through either an article or a book.

**The Ongoing Effects of Hollywood's Beauty Criteria on Yeşilçam Actors and Actresses**

In the silent motion pictures period, along with the words, fame and even faces were almost absent and the technology was not developed enough to transfer everything in detail. Maybe this was the reason why makeup was not that important: So we do not observe dominant makeup examples. It is movement-oriented and depending on an incident. The message arises from an act or incident. In the beginning, the characters seem to be weak. The first examples of makeup are seen on Laurel of Laurel and Hardy. There is kohl on Stanley's eyes. Gestures facial expressions are important and this may have been considered necessary because Laurel's eyes could not be differentiated from the frame enough. Charlie Chaplin's makeup is much more significant. Like a clown… This kind of makeups has been present since the beginning of the theatre. The purpose is to ensure even the most distant spectator can see it and furthermore, to transfer the emotion, sustain the continuity of the watching, ensure the focusing and of course, impressing.

The development of the technology has revealed for the directors the necessity that the face and body should be more significant and clear and that the actors and actresses should be much more careful than before. Ways to be effective and attractive on the magical screen have probably been researched. It is not a desirable situation for a celebrity to be overweight. Moreover, the movements of an over-weighted person are limited. Note that, the public emulates the characters idealized as a role model. Or this is the perception created: 'you should take the ideal as the role model; and it is me who creates the ideal patterns'. Is it possible that the aesthetics sector in the entire world is formed in this way? What are the possible reasons that these created beauty criteria are still considered as the ideal criteria in third world countries and developing countries? There is a technology that is being used also in the aesthetics world and it may be so valuable that it cannot be thrown to the garbage with every value and this is because the entire system may have been established on 'money'.

European cinema does not have such a problem. There are all kinds of people: there are more human and it is more human-oriented, it is more realistic, it includes more humane problems and therefore it is more of an art branch … Just like theatre… It is improvement-oriented, established less on the exploitation system… In fact, when you look from the physical aspect, they don't seem to need aesthetics that much: for example the Sweden cinema; smaller noses, colorful eyes, and they seem fitter and healthy perhaps due to their healthy food habits…

How should the role models who are being imitated be? The aesthetics industry will be brought into existence; it will be one of those sustainable sources of money and this industry will be constantly supported by Hollywood cinema.

Role models to be effective when seen in the frame: thick lips, big eyes, well-shaped thick eyebrows, and there should be a distance between the eyebrows and the eyes. Abundant hair with brilliantine, suits, tie, flowers on the neck, ironed trousers, tight dresses, flaring skirt dresses, elegant, dresses with full pleat skirt (Marilyn Monroe's subway dress) https://www.youtube.com/watch?v=ej5vaUwDsp8

Once the role model impression is created, the sales will always realize this through these 'famous' role models. More well-coordinated, hitting target and effective, the science must have been also benefited from.

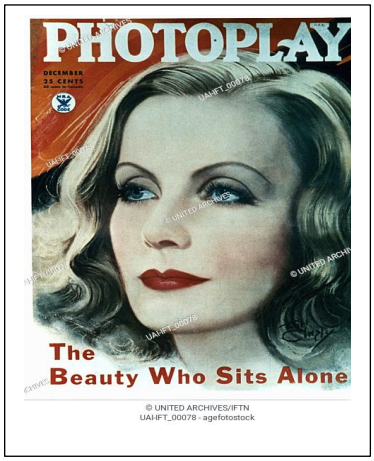
It is quite certain that Hollywood actors and actresses were effective on Yeşilçam actors and actresses not only in terms of visuality but also acting. Filiz Akın has told in the interviews she made with reporters that she had many times watched and tried to imitate Kim Novak's stance and glances against the cameras. Although the actors and actresses were unaware of this situation, it was impossible for the directors to be unaware. At the end of the day, the actors and actresses taking their place in Yeşilçam were not coming from extremely wealthy families. Some has completed their education while the rest discontinued. Later on, the money-oriented position remained intact, however, in an attempt to attract more educated people to the cinema for more sectorial success, many actresses were removed from the university environment, particularly from one university. This information has also been taken from the public through digital environments.

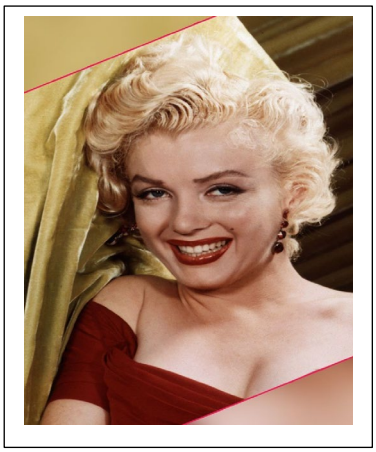
Greta Garbo look, Marilyn Monroe who was inspired by her and made the same makeup, and Cahide Sonku and Bedia Muvahhit among Yeşilçam actresses who imitated this sleepy look

https://www.agefotostock.com

In Turkish cinema of Yeşilçam period, female visuality came first. Visuality is a concept which encompasses attractiveness for a woman and is equivalent to beauty. Adjectives used for women such as beautiful eyes, full-figured body, slim waist, long hair are the reflections of the



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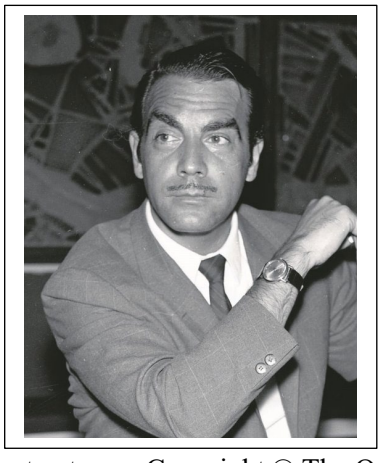
values of the general society about liking on female artists. One of these artists is Türkan Şoray: She has enabled conversion of praises of female appearance as embraced and supported also by women in Turkish culture with her eyes, eyelashes, looks, hair and full-figured body to a cultural code as done by women(Algül, 2017:198)

Visuality praising in Yeşilçam: These data which were announced to be physically superior, apply to also men in different qualifications. There was a period even this handsome and fit male actor rule has been attempted to demolish in line with rumors heard among the public. All of them were moves towards realizing more sales.

Clark Gable moustache, look and Ayhan Işık, Kim Novak and Filiz Akın



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## Results and Discussion

In the magical effect of the cinema, the designs of the movie houses that are indexed to the developing technology have a big role. A huge dark movie house which is silent first and noisy later on, first colorless and colorful and magical images later on: which talk about other lives, other lands other worlds. That creates a hypnotic effect and attract all the attention, and that is equipped with the most accessible technology of the period; an environment that all the senses are ready to get and that is thirsty for stealing all the humane senses, and having hitting, impressive and transforming characters to the same extent and could play to this. For this reason, the way and purpose such important and transforming power is used is important to the same degree. Therefore, in order to protect the identity and integrity of the state and not to be deceived by the company-state plan of the imperialist powers, it may be a solution for everyone to go through an inquisitive education from the early childhood. The roads to the solutions of all problems come to *education* because the thing that we call *education*: is not something that can be realized without information transfer.

It is also the Hollywood cinema industry that is being modeled. Everything is established on money and sales. Above all, together with the digital age, Turkish cinema may engage in a race with Netflix and Hollywood in terms of exploiting the digital media to gather a bigger number of spectators. It is acting as if they are a common culture fueled by the same source: it seems like cultural texture that has a structure which is placing money on top of all kinds of humanitarian values, rejecting the humanitarian values if they are not being used for returning profit and that has been inured through centuries (transition of genetic code). Commercial morality (!) seems to be restructured on this cultural texture. Working conditions, the seizure methods of the subjects to make commercial sales (various plagiarism cases and unrevealed digital enslavement), attitudes considering everything as fair for the sake of money, to use everything for ensuring sales and doing this by its very nature, doing this without any discomfort can possible only through internalization that becomes a reflex. This kind of movie-making culture is not a movie-making culture that has arisen from the core of this land. The development of the cinema sector which has started with Yeşilçam has occurred in this direction and this will be the subject of a separate study. There is the internalization of humanitarian values in the essence of the Anatolian land. There is

  

humanity and one cannot dice with the lives of people for profit or money. And since the same team is monopolizing also the TV sector, the folks and the ensnared people become the natural victims of this system and solutions for this problem have to found promptly.

The interesting part is that these beauty criteria are still relevant for some people even in 2019. Or the fact that these kinds of personalities are still preferred because they can work only with them. Even if Netflix and even Hollywood which have realized that it will fade away in this way have started to give place in a wrong way to people who may otherwise be ordinary. This 'mistake' is so comprehensive that it can be the subject of a book, therefore, it will not be elaborated in this article.

The answer that will be given to this question will be one of the auxiliary element for understanding the general mindset.

Are the products of IKEA being advertised mostly in Swedish movies or rather in Netflix and Hollywood movies?

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# DETERMINING UNMANNED AERIAL VEHICLE DESIGN PARAMETERS FOR AIR POLLUTION DETECTION SYSTEM

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**Abstract:** The expansion of the use of unmanned aerial vehicles has developed new ideas and applications. The use of unmanned aerial vehicles has a wide target range from postal distribution to agricultural land inspection. The aim of this study is to design unmanned aircraft systems that can analyze air pollution from specific points, transfer instant pollution information to computer and transfer images to desired points. The important point in the design is that the aerodynamics of the mechanical structure give the most effective results at high altitudes and changing wind speeds. In this study, a quadcopter was designed to be used in instant air measurements. In the computational flow analysis applied on the design, for air flow values of 10m / sec, 15m / sec, 20m / sec and 25m / sec; The effect of pressure, turbulence and velocity variables were investigated. As a result of the analysis, no results were found to affect the vehicle's ability to move in these parameters. As a consequence of the studies and analyzes, it is concluded that this design is suitable for instant air pollution measurements.

**Keywords:** Unmanned Aerial Vehicles , Air Pollution, Computational Analysis of Quadrotor, Aerodynamics

## Introduction

A multicopter is a helicopter with multiple propellers. It may have 2, 3, or more propellers. The most used multicopter versions are: T Copter (2 engines), Y Copter (3 engines), QuadCopter (4 engines), HexaCopter (6 engines).

These systems are powered by rechargeable lithium polymer batteries. Multicopters need a flight controller to stabilize in the air. These controllers contain various sensors. There are several types of sensors depending on the controller to be used such as gyro, acceleration sensor, magnetic field sensor, global positioning system, ultrasonic sensor, and pressure sensor.

The quadcopter, which is a more stable and symmetrical unmanned aerial vehicle, is a 4-rotor vehicle that meets the definition of a VTOL (vertical take-off and landing). Unlike normal helicopters, the quadcopter does not have a tail rotor to correct the inertia created by the engine, instead, coaxial pairs of propellers provide stability by rotating in opposite directions to each other and adjusting the RPM (revolutions per minute) every second.

Quadcopters have some advantages over the helicopters in similar size.
First, Quadcopters do not need mechanical connections to change the propeller angle. This simplifies its design and maintenance. Secondly, the diameter of the engines is small since four engines are used, which means that they have less kinetic energy during flight so that the engines get less damage in the event of a possible collision. Quadcopter chassis is frequently used in amateur model flight projects thanks to ease of construction and control. Another advantage of the quadcopter is that it is more efficient and lighter than real helicopters and other people-carrying vehicles because it works with electrical energy. However, it is a disadvantage that the mechanically full-scale model is quite difficult to construct and fly (Göl, 2019).

## Materials and Methods

First of all, if we examine the assembly of the components and electronics of the mechanics to be analyzed; it is produced with carbon fiber structure with a front surface which will slow down the speed of the fluid in dense airflow.

  

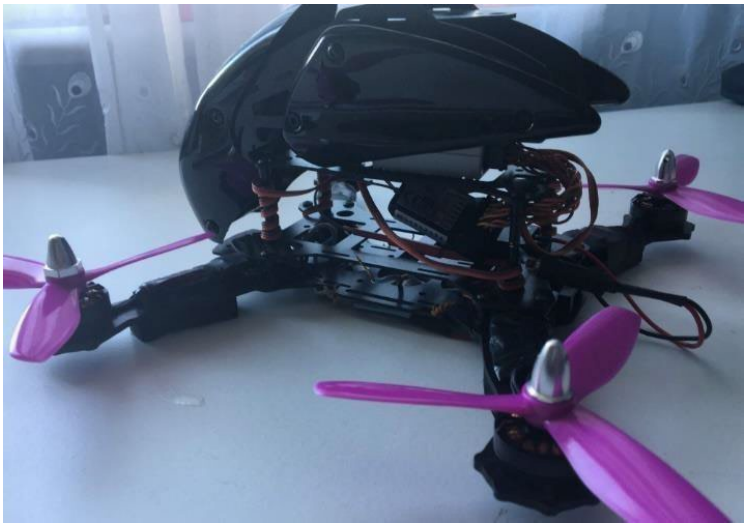

**Figure-1:** Image of our quadcopter after its assembled

We used drawing in the design stage and Solidworks software for CFD analysis and tensile stress analysis.

| Quantity | Hardware |
|---|---|
| 4 | Readytosky 2212 920KV Brushless Motor |
| 4 | Emax 12A ESC |
| 1 | Profuse 25C 2250mAH 3S Battery |
| 1 | Flysky FS-R6B Receiver |
| 1 | Flysky FS-I6 Transmitter |
| 1 | Carbonfiber Frame Parts |

**Table-1:** Hardware Equipments

| Quantity | Software |
|---|---|
| 1 | DJI NAZA M-LITE |
| 1 | SOLIDWORKS |
| 1 | ANSYS |

**Table-2:** Software Equipments

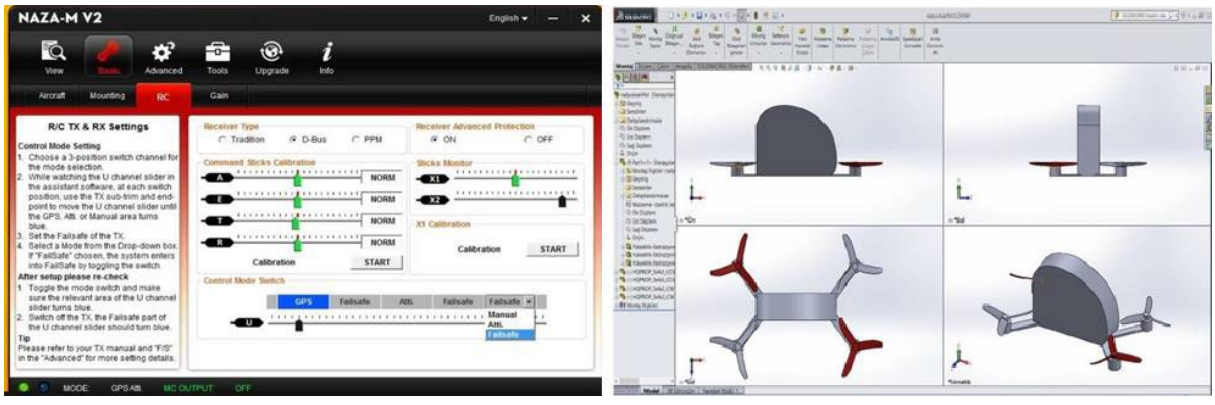


**Figure-2:** Using softwares

DJI Naza M-Lite Assistant software was used to configure the Quadcopter's flight control.

The propeller converts the mechanical energy generated by the engine into a propulsion force by accelerating the air mass in front of it in the opposite direction to the aircraft's movement direction. The force that pulls the quadcopter forward/backward and right/left is obtained by increasing the fluid momentum backward according to

  

the aimed direction. This momentum increase is usually achieved by accelerating the air backward using a propeller. Quadcopters have 4 propellers; two clockwise (CW), and two counterclockwise (CCW). The direction of rotation of the engines and propellers facing each other are opposite at the quadcopter, which has a different structure from the helicopter.

The design with the most ideal dimensions for the propeller structure is called aerofoil (wing profile). Aerofoil is a 2D cross-section of objects moving through a fluid such as a propeller. These cross-sections are designed to provide the optimum drag ratio to the vehicle moving through any fluid such as air and water. We wanted to examine the difference in flow analysis by drawing 3 different propellers before the analysis.

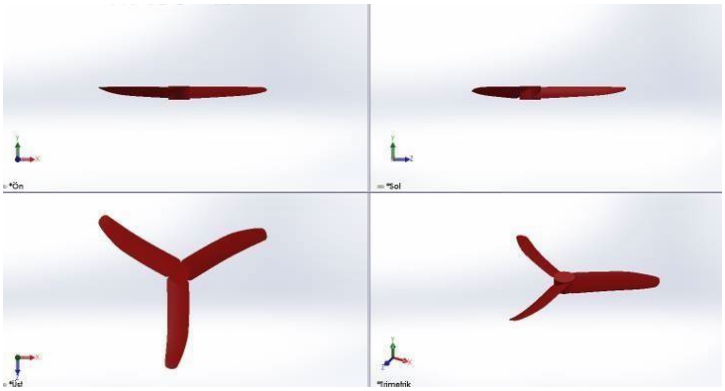

**Figure-3:** CCW Aerofoil Propeller

In the ideal disc theory developed by Froude, instead of a propeller, an infinitely thin disc of the same diameter is taken and the momentum gained by the air passing through it is examined. However, the following assumptions are made during this examination:
- The fluid passing through the disc gains energy in the form of static pressure increase. The energy gained is the same on all sides of the disc.
- The velocity of the air particles passing through the disc is the same. The flow is constant and irrotational. Vortexes at the propeller outlet are omitted.

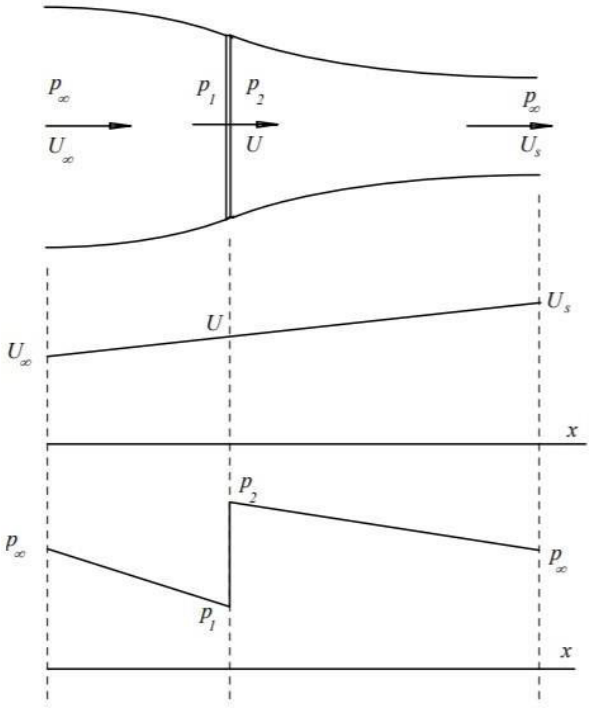


**Figure-4:** Bearing Disk

In front of the propeller and far enough away from it, the air comes to the propeller with a speed of U∞ equal to the speed of the aircraft and it accelerates as it approaches the propeller, reaching the speed of U on the disc. It

  

continues to accelerate after the disc and reaches the speed of us far enough behind. Parallel to this speed increase, the static pressure of the air decreases as it approaches the propeller and decreases to the value of p1 in front of the disc, increases to the value of p2 behind the disc with the energy it gains from the disc and again decreases to the static pressure p∞ at infinity by gradually decreasing behind the disc. The velocity of the air passing over the disk is equal to the arithmetic mean of the free stream velocity and the advanced velocity of the propeller.

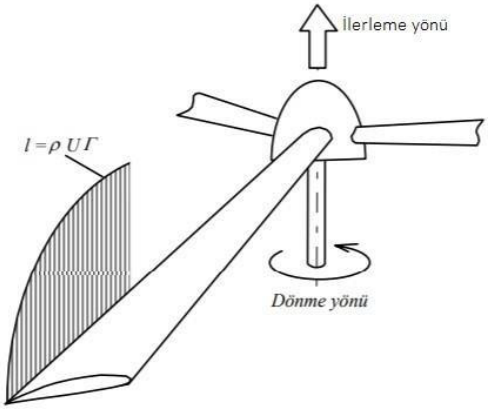


**Figure-5:** Load distribution through propeller pal[2]

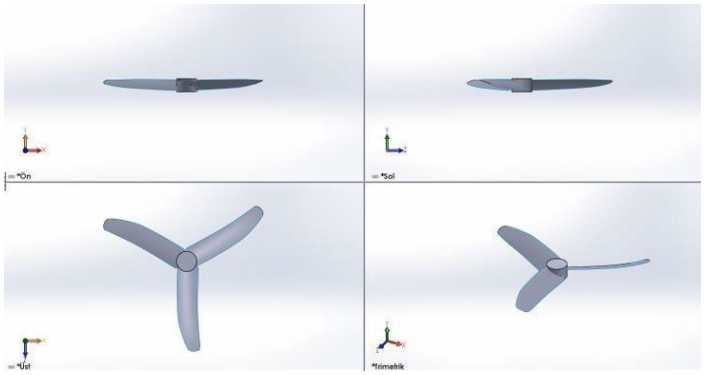

**Figure-6:** Slenderized Aerofil Propeller

It is possible to consider each blade of a propeller as a three-dimensional wing. However, this wing makes a rotational movement around the root and a propulsion motion in the direction of its trailing edge. Under the influence of these movements, a lift force is generally formed on the propeller blade in the direction of propeller's motion, however, due to tip effect, as in the three-dimensional wing, the lift force which is zero at the blade tip, shows a change along the blade

As a result, evacuation vortices are formed on the trailing edge of the blade, and these vortices roll over each other in the blade to form a tip vortex.Trailing edge vortices formed in the same manner on the track of a three-dimensional wing are spread behind the wing so that they remain in the plane of movement of the wing while they are spread along helical trajectories, due to the common effect of the propeller's rotational and propulsion movements in the footsteps of a propeller.

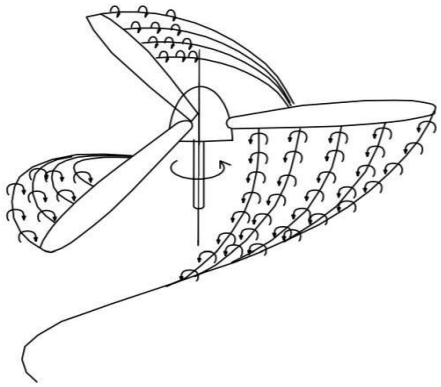

**Figure-7:** Vortex System around propeller

  

When the close track of a blade is examined, it is seen that the trailing edge vortices are propagated along the helical trajectories towards the back of the propeller as indicated above, rather than within the blade's rotational plane behind the blade.
In order to better examine the effect of these vortex lines on the stream area around the blade, it is useful to divide them into two components in the plane of rotation and in the direction of propulsion.

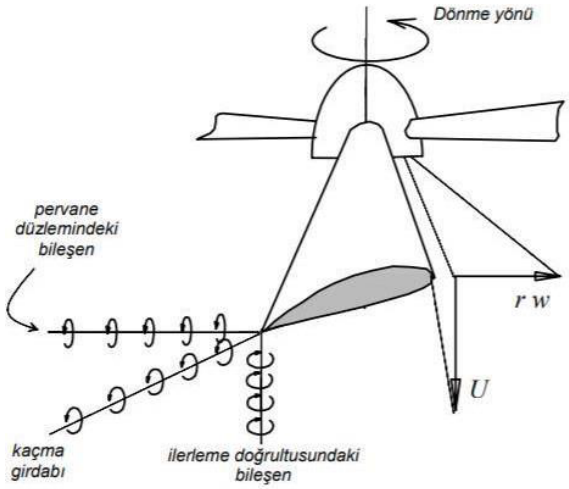


**Figure-8:** Components of vortex lines(Yükselen,2019)

The vortex lines of the component in the rotation plane induce velocities in the same direction as in the three-dimensional wing in the direction of the blade belly, i.e. in the direction opposite to the propulsion direction of the propeller. These induced velocities are the increase in the flow velocity in the disc plane in Froude momentum theory. It is known that the induced velocity decreases as the wingspan increases in the three-dimensional wing. On the other hand, according to Froude's theory, the faster the stream passing through the disc is, the higher the ideal efficiency is. As a result of Froude's theory, the dependence of the ideal yield on the propeller area and the speed in the track, it is stated that increasing the diameter of the propeller instead of increasing the speed in the track will positively affect the ideal efficiency (Yükselen,2019).

## Results and Discussion

Fluid analysis of propellers was examined before the general mechanical structure. After the compatibility of the propellers, the entire structure is examined.
The simulation of the propellers exposed to the air in a closed system was carried out using Flow Simulation extension of Solidworks.
If the steps of computational fluid analysis of the counterclockwise aerofoil propeller are examined;

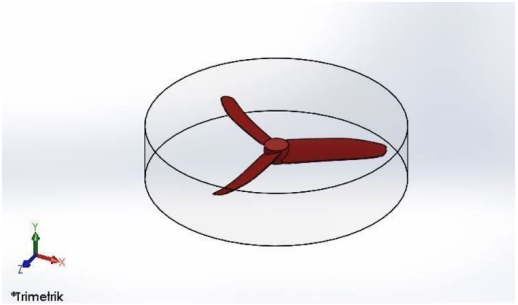


**Figure-9:** Propeller in the Cylindirical Flow Area

First, the boundaries of the rotating cylindrical field are determined to ensure that the propeller becomes independent of external factors. And the propeller was placed in the cylindrical structure with a volume of 85 $cm^3$ (h=15 mm, r=75 mm) [Figure 9]. The speed of this rotating cylindrical field is set to (-)1100 rad/sec. The reason

  

is that the angular speed is proportional to the RPM of the engine we proposed to use. The faces to be examined are selected. On each face of the propeller, the effect of airflow on velocity was examined. When we examine the airflow that we sent from the Z-axis;

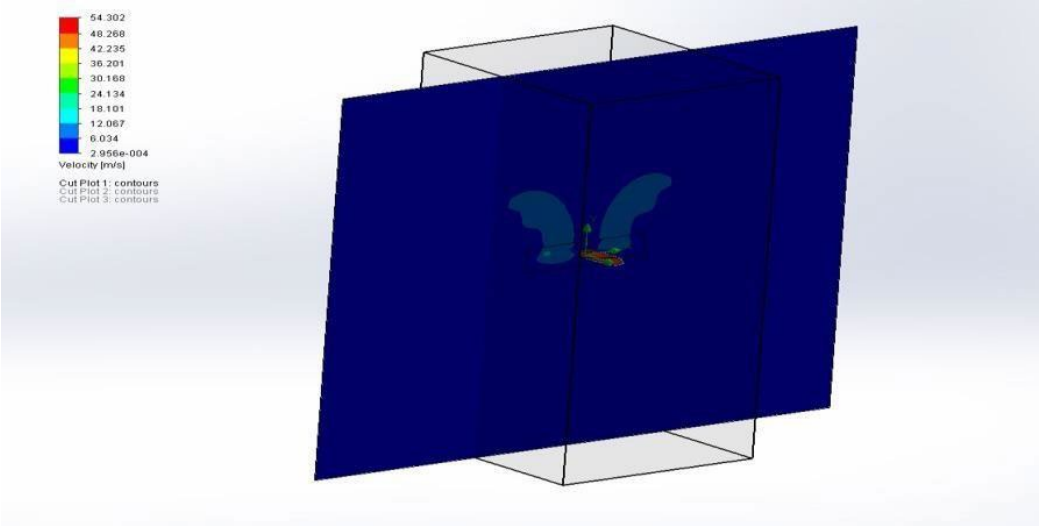


**Figure-10:** Z axis of the air flow simulation.

When we examine the propeller's reaction to the airflow that we sent from all three axes;

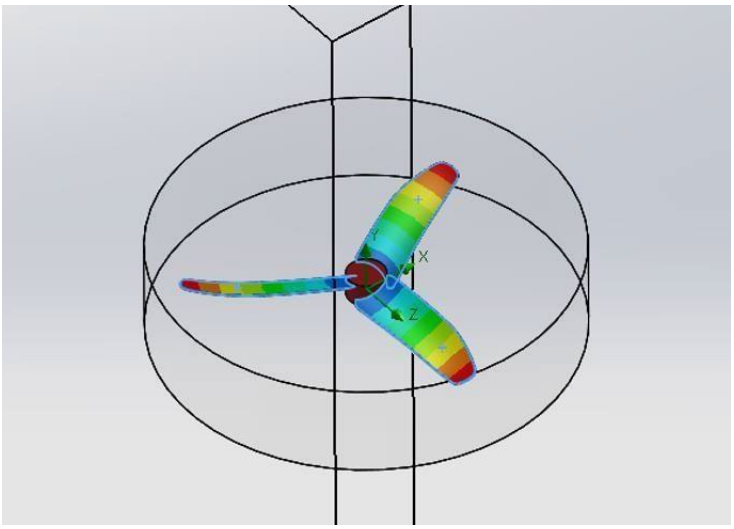

**Figure-11:** Propeller in the Cylindirical Flow Area

Thus, the hub and the radius points of the propeller are more affected by the airflow. We said that airflow does not occur in one direction in propellers, unlike the airplane wings. Airflow in various directions according to the direction of each blade of the propeller will be monitored. When we observe the airflow direction from a general angle for the counter-clockwise propeller;

  

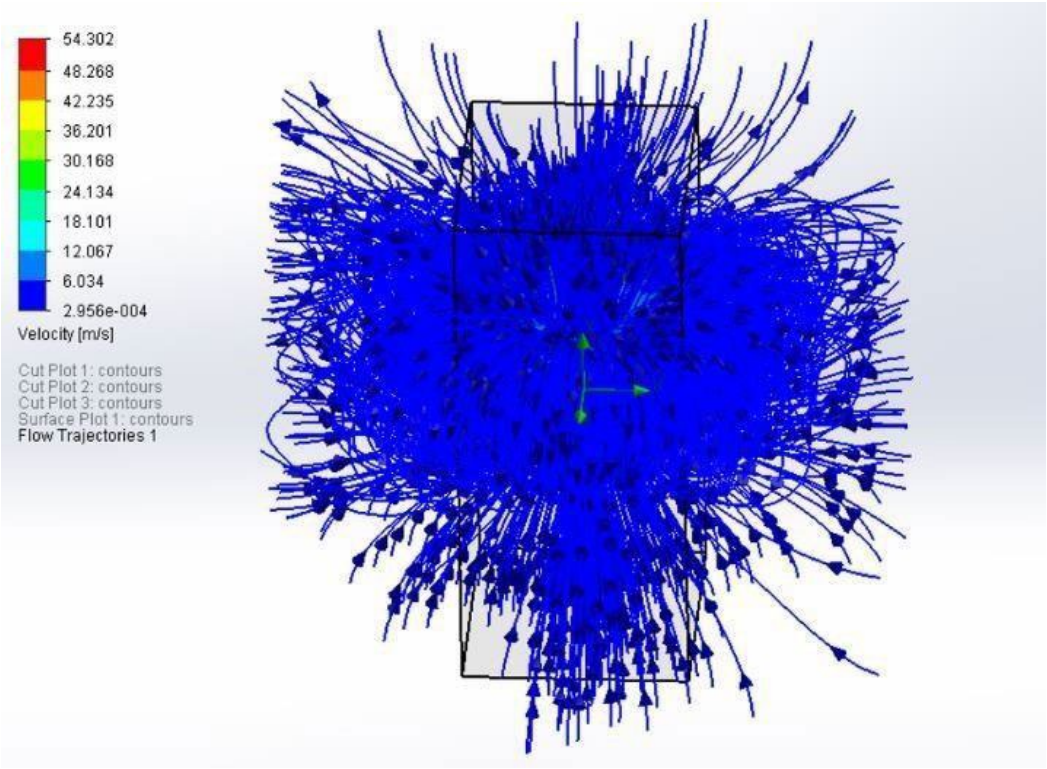


**Figure-12:** Impulse Force Directions

Usually, we see that the air entering from the (-) Y-axis disperses and move towards the (+) Y-axis, and the air coming from the (+)X direction led towards (-)X direction.

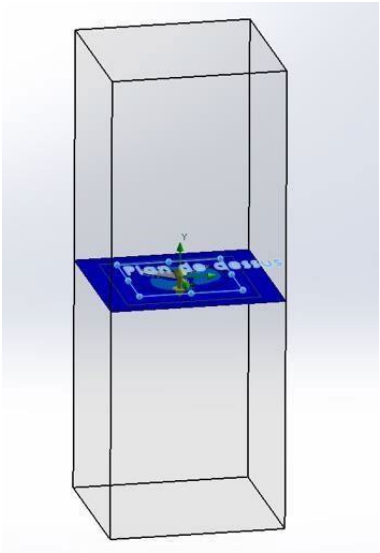

**Figure-13:** Y-axis air flow at CW propeller

If we examine the flow analysis of the clockwise propeller, we see that there is no change in the flow velocity graph acting on the surface, but only the propulsion forces will be different.

  

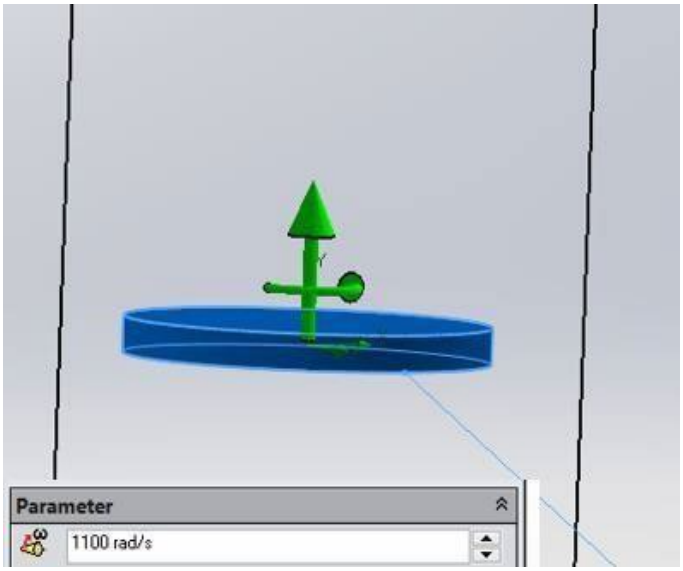


**Figure-14:** A figure that shows angular velocity is in the (+)Y direction at CW

Computational fluid analysis of the vehicle which was drawn in three-dimensions was carried out using Ansys software. First of all, the drawing was imported into the program and the vehicle was placed in a rectangular closed system of 2x5x2 m3. Airflow was sent to the system at speeds of 10m/sec, 15m/sec, 20m/sec, and 25m/sec respectively.

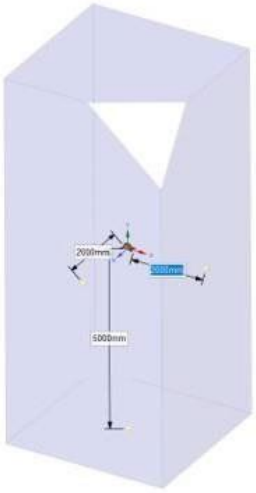

**Figure-15:** Isolated system that is simulated

3 reference points are taken from the quadcopter placed in the isolated system. These points, which are expected to be the most efficient points in the analysis, are the center of the front right propeller, center of the front left propeller, and the center of the vehicle body.

**Figure-16:** Quadcopter that is in the isolated system

  

After defining the reference points of the vehicle and selecting the fluid material as air, the simulation is advanced and the network structure of the model is formed. The reference coordinates are entered as indicated in Figure 17.

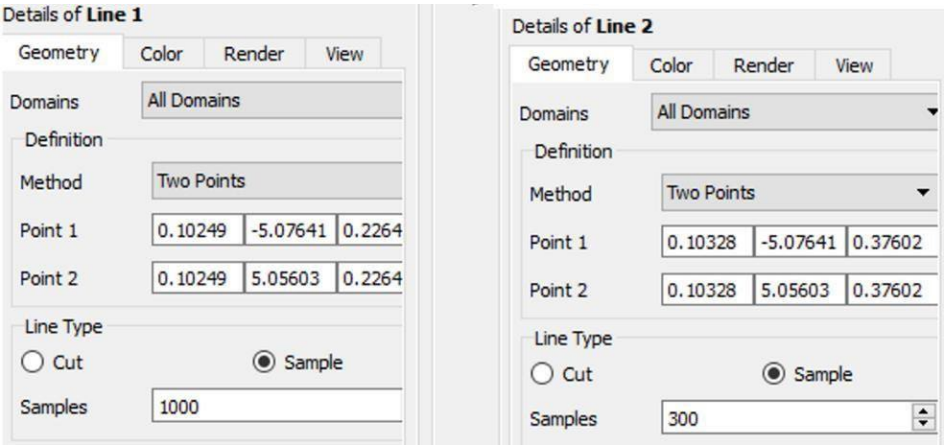


**Figure-17:** Reference coordinates

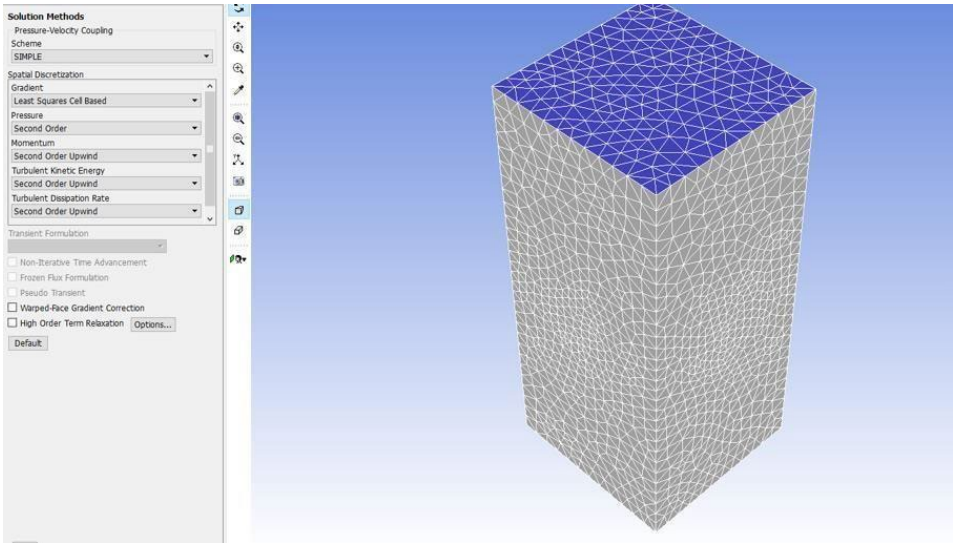


**Figure-18:** Network Topology of the model

The number of nodes, the number of elements in the model, and the number of network structures divided into tetrahedral are indicated in Table-3.

**Table-3:** Model's spefications

| Domain | Nodes | Elements | Tetrahedra |
|---|---|---|---|
| Model | 155572 | 909851 | 909851 |

Three variables were defined to analyze the model. As a result of the analysis, the effects of airflow on velocity, pressure, and turbulence kinetic energy is observed.

  

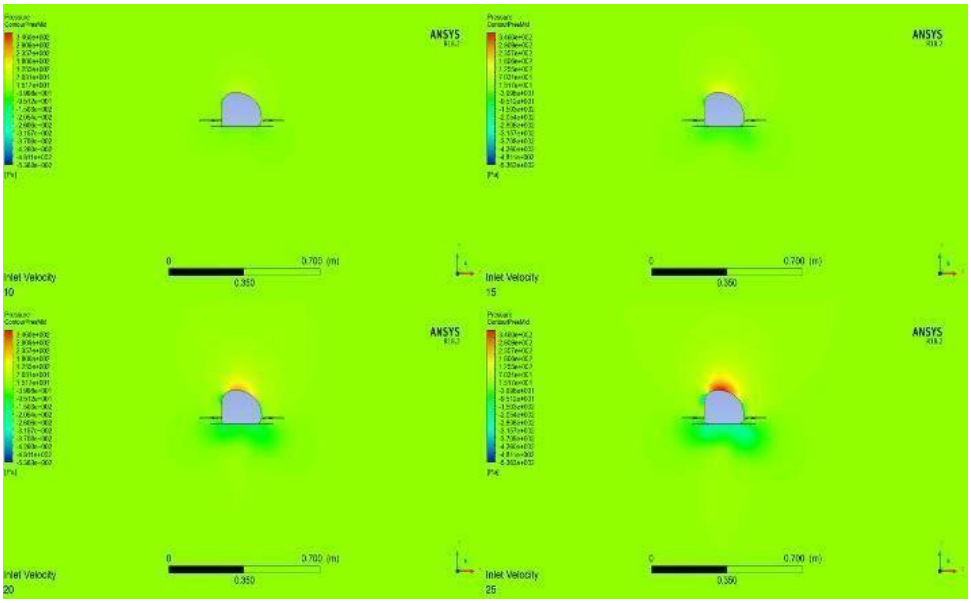


**Figure-19:** Pressure effect through the center of aircraft

When the above figure is examined, the effect of pressure on the center of the vehicle is increased when airflow rates are increased. However, this pressure level is not enough to prevent the mobility of the system. Only the upper part of the vehicle that is exposed to the air flow of 25m/sec is affected.

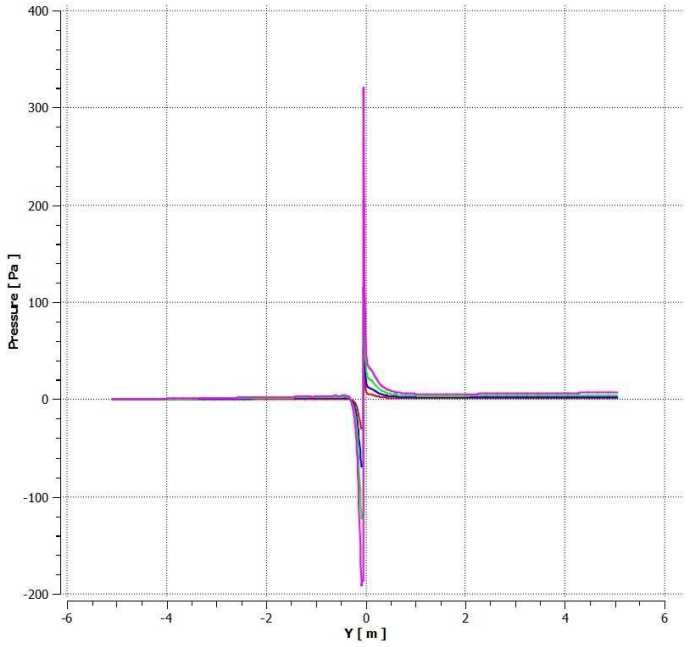


**Figure-20:** Pressure effect on front-left propeller

When the result in Figure-20 is examined, the increase in the airflow rate does not create a pressure effect at a level that would have a negative effect on the surface of the propeller.

  

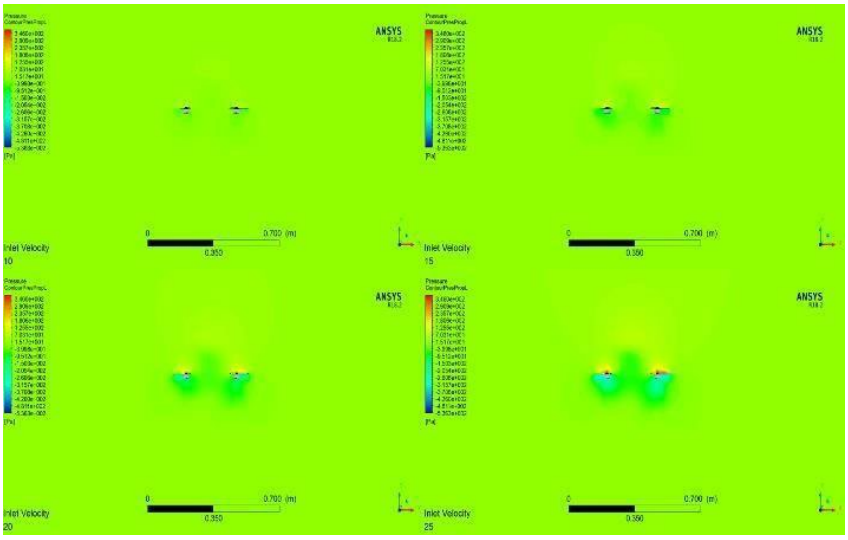

**Figure-21:** Pressure change for four different velocity values

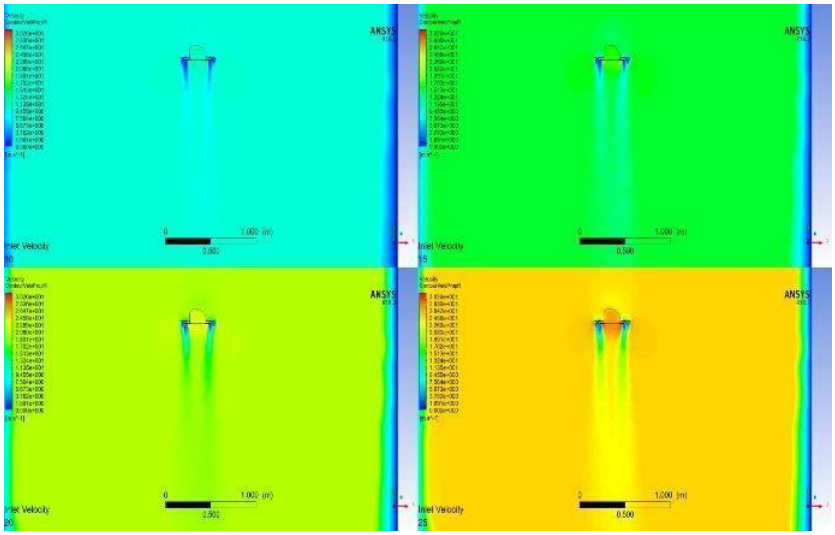

**Figure-22:** Velocity effect on the center of aircraft

The pressure value reaches its maximum level when the vehicle meets the airflow coming from +Y direction. The airflow, which is not in contact with the vehicle, regains its former stability.

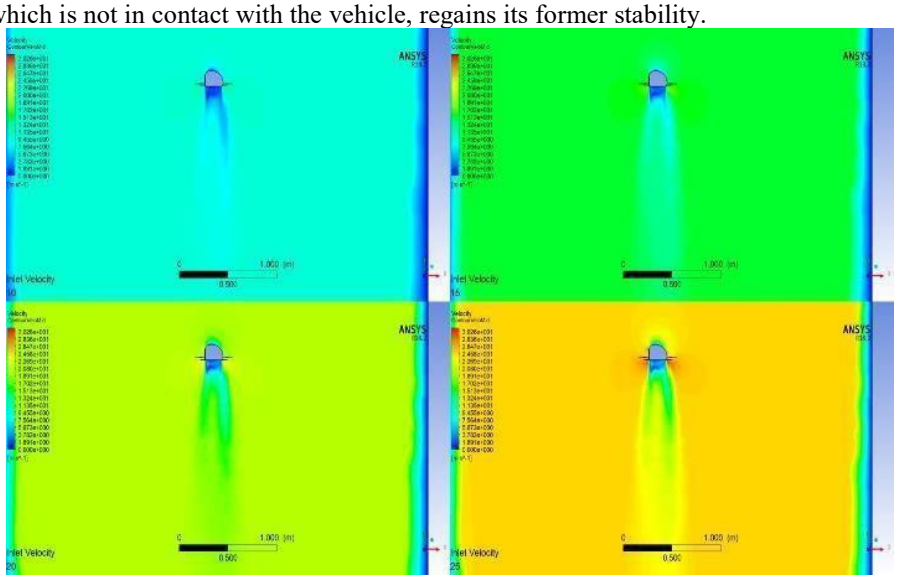

**Figure-23:** Velocity effect on front-right propeller

  

When we examine airflow with four different velocity values that effects the center of the body,it is observed that while velocity values increase,reaction of body increases too. The maximum value for this reaction is observed under the body of the vehicle exposed to the wind of 96 km/h.

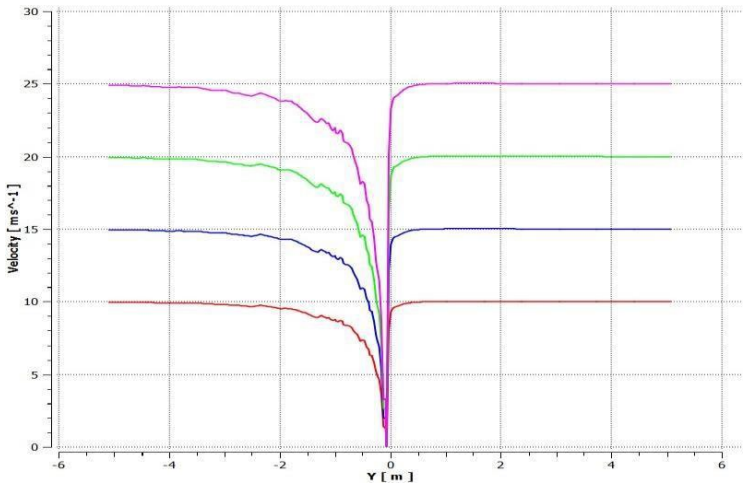


**Figure-24:** Effect of the four different velocity to the aircraft's velocity

The velocity of the air sent in the +Y direction is damped by the vehicle as soon as it meets the vehicle. After the air contact with the vehicle ceased, it decayed for approximately 4 m and then became stable (Figure-24).

In other words, the vehicle has an immediate damping effect on the air when it contacts with the air. The velocity of the air became exponentially stable after the contact was stopped.

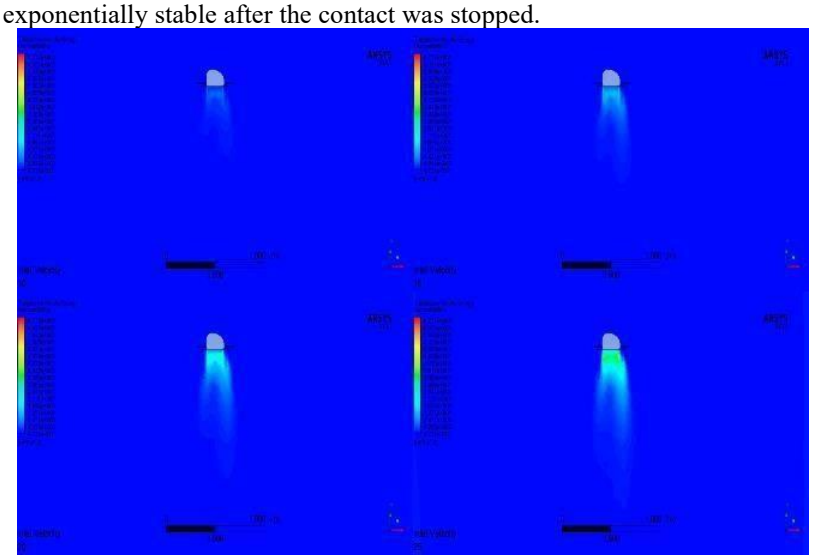

**Figure-25:** Effect of the kinetic energy on the center of aircraft

The turbulence kinetic energy acting on the vehicle is shown in Figure-25. When the graph is examined, turbulence kinetic energy is increased in direct proportion with increasing velocity values of airflow. This energy is observed starting from the bottom of the vehicle body to an average distance of 2 meters from the lower body. As the airflow moves away from the vehicle, the turbulence kinetic energy becomes zero again. It was observed that the turbulence kinetic energy generated in the vehicle was not at a level that would prevent the movement of the vehicle at the simulated speed values.

  

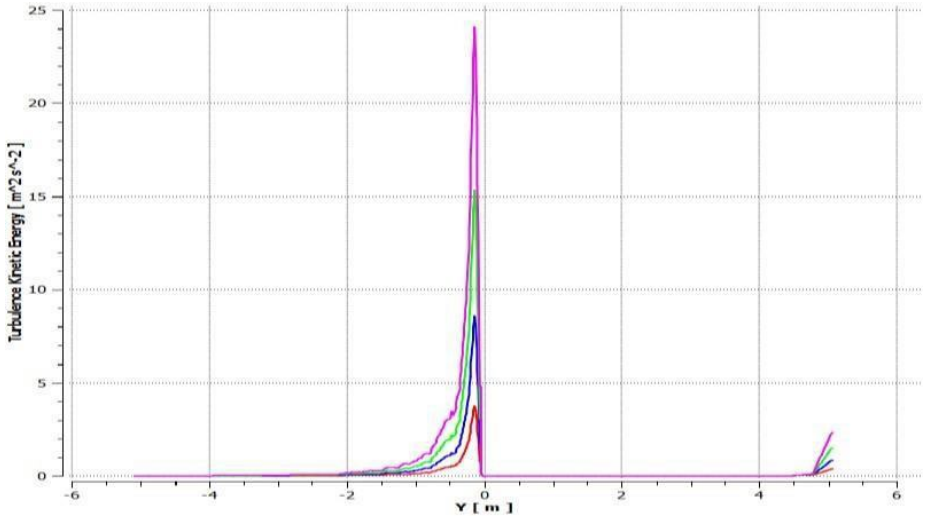


**Figure-26:** Effect of the four different velocity to the aircraft's turbulence kinetic energy

## Conclusion

In this study, a quadcopter was designed to be used in instantaneous air pollution measurements. In the computational flow analysis applied on the design for airflow values of 10 m/sec, 15 m/sec, 20 m/sec and 25 m/sec, the effect of pressure, turbulence, and velocity variables were examined. No results were found to affect the vehicle's mobility in these parameters at the end of the analysis.

As a result of the studies and analyzes, it is concluded that this design is suitable to be used in instantaneous air pollution measurements. The production of the designed vehicle was realized.

## Acknowledgments:

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# NUMERICAL MODELING OF A PHREATIC AQUIFER FLOW IN WESTERN BURSA

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**Abstract:** The aim of this study is to develop a numerical model of groundwater flow in the lower part of Susurluk Basin located within the boundaries of Karacabey and Mustafakemalpaşa districts of Bursa, Turkey. For this purpose, daily groundwater levels from 5 observation wells were acquired for years between 2013 and 2015. Daily precipitation and evapotranspiration values of several stations in the region were obtained from the General Directorate of Meteorology. In GIS environment, the wells were marked as points and boundaries of the basin were determined using a topographic map and a Digital Elevation Model. Shapefiles containing aquifer boundaries and well locations were transferred to MODFLOW interface. The groundwater flow simulations were performed for years between 2013- 2015 and the groundwater level distribution was obtained. Hydrologic parameters were also estimated.
**Keywords:** Groundwater, MODFLOW, Numerical Model

## Introduction

Various software are available in the field of groundwater modeling. MODFLOW (McDonald and Harbaugh 1988), MIKE-SHE (Refsgaard and Storm 1995) and MODHMS (Panday and Huyakorn 2004) can be given as example. MODFLOW is the most widely used model. For example, Gaur et al. (2011) used Geographic Information Systems (GIS) for watershed management and MODFLOW for groundwater modeling in the study of the Banganga River basin. Wang et al. (2015) modeled the effect of precipitation density on groundwater levels with MODFLOW. Korkmaz et al. (2016) modeled the underground and surface water flow of Eskişehir basin with MODFLOW for transient conditions. Nkhonjera et al. (2017) investigated the importance of direct and indirect effects of climate change on groundwater of the Olifants River basin by basin modeling. Boughariou et al. (2018) modeled the aquifer behavior in the Sfax region of Tunisia by using GIS and MODFLOW 2000 under climate change and high consumption conditions. Liu et al. (2018) conducted basin modeling with MODLFOW in order to investigate the effects of intensive agricultural activities on the groundwater dynamics in the oasis regions of the arid inland river basins in northwestern China.

MODFLOW is a 3D, cell-centered, finite difference, saturated flow model developed by the United States Geological Survey (McDonald and Harbaugh, 1988). MODFLOW can perform both steady state and transient analyses and has a wide variety of boundary conditions and input options. MODFLOW uses a combination of three-dimensional water balance equation and Darcy's law as the governing equation:

$$\frac{\partial}{\partial x}\left(K_{xx}\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_{yy}\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_{zz}\frac{\partial h}{\partial z}\right)+W=S_s\frac{\partial h}{\partial t} \quad (1)$$

where $K_{xx}$, $K_{yy}$ ve $K_{zz}$ are the hydraulic conductivity values along the x, y and z coordinate axes, $h$ is the potentiometric aquifer head, $S_s$ represents the specific storage, $W$ is the source/sink term (per unit volume) and $t$ represents the time. In the steady state conditions, the right-hand side of Eq. (1) equals zero.

In this study PEST was used for parameter estimation. PEST is a general purpose parameter estimation utility developed by Doherty (2013). The purpose of PEST is to assist in data interpretation, model calibration, and predictive analysis. GMS provides a custom interface to the PEST utility offering a simple way to set model parameters and a graphical user interface to run the model and visualize the results.

The aim of this study is to develop a numerical model of groundwater distribution in the part of Susurluk Basin located within the boundaries of Karacabey and Mustafakemalpaşa districts of Bursa, Turkey. Within this scope, daily water levels of 5 observation wells between 2013 and 2015 were acquired. Daily precipitation and evapotranspiration values of the stations in the region were obtained from the General Directorate of Meteorology. In GIS environment, the wells were marked as points and boundaries of the basin were determined using a

  

topographic map and Digital Elevation Model. Maps of aquifer boundaries and well locations were transferred to MODFLOW and a grid with a resolution of 150 m x 150 m was generated. By entering precipitation and evapotranspiration values of the years between 2013 and 2015, the groundwater level distribution of the basin was computed. Hydrologic parameters were estimated.

## Materials and Methods

The basin used in the study is the part of the Susurluk basin within Karacabey and Mustafakemalpaşa districts of Bursa, Turkey. Uluabat Lake to the east of the basin, Mustafakemalpaşa Stream to the southeast, Mount Çataldağı to the south, Manyas Lake to the west, Marmara Sea to the north. Susurluk River passes through the basin and continues towards north and flows into the Sea of Marmara. However, the modeled basin is bounded by Susurluk River in the north and west and Mustafakemalpaşa Stream in the southeast (Figure 1). The geology of the study area is mainly composed of alluvial plains and river sediments. In general, the topography consists of low plains in the north and the height increases to the south.

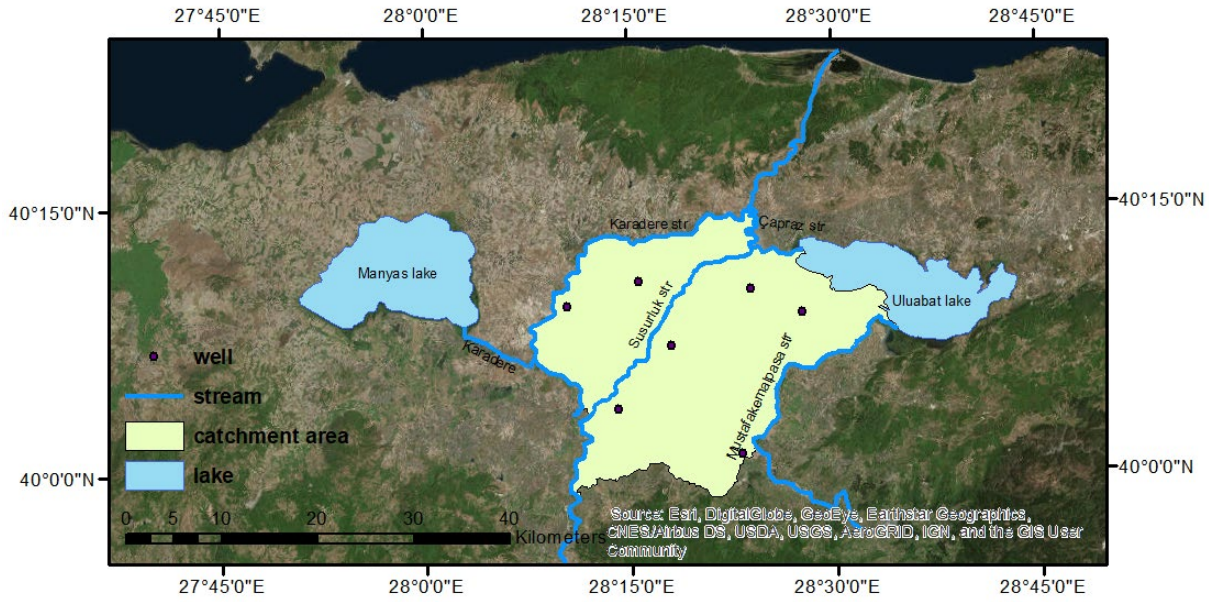


**Figure 1.** Study Area

Initially, the data of 5 observation wells were acquired from State Hydraulic Works. 3 of these wells are located in Karacabey and 2 in Mustafakemalpaşa districts in Bursa. The data includes hourly water and barometric pressures recorded between 2013-2015. The external parameters that affect the groundwater level of the basin are precipitation and evapotranspiration. Daily precipitation and evapotranspiration values measured between 2013-2015 at observation stations in Karacabey and Mustafakemalpaşa were obtained from the General Directorate of Meteorology.

Basin delineation was done in GIS environment. Aster GDEM raster files with a resolution of 30 m x 30 m were used to determine the basin area. The raster file was converted to point heights for use in MODFLOW. Hydrological analysis of the basin was performed using the ArcHydro toolbar. Shape files were created and the wells, rivers, lakes and meteorological stations in the basin are plotted on the map.

A diagram for modeling process is given in Figure 2:

  

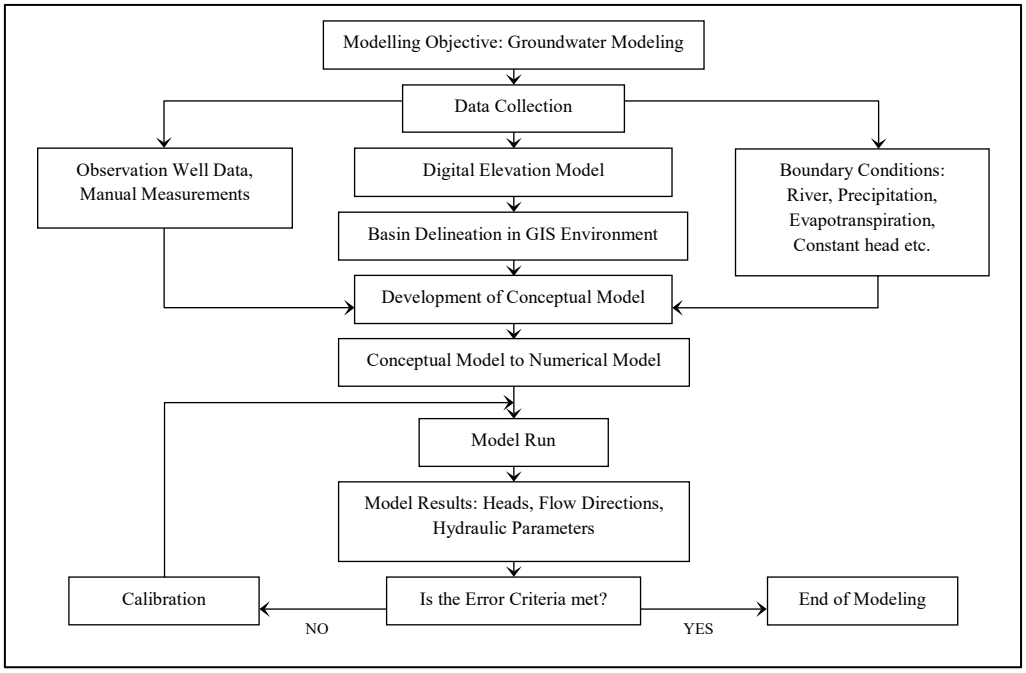


**Figure 2**. Work flow diagram of modeling

Numerical modeling was done in GMS program. GMS is a program that provides graphical interface for MODFLOW. GMS generates and records input data for and visualizes the output from MODFLOW. Files transferred from the GIS environment to the GMS appear as shape files. These files were transferred to the newly created conceptual model in order to transfer the spatial data to MODFLOW grid. In the generated grid cell size was 150 m x 150 m on x-y plane, and it composed of 1 layer in z direction.

MODFLOW 2005 was selected as version and model type was selected as steady state. LPF (Layer Property Flow) was selected as the flow package and PCGN was selected as the solver. Point elevations were used as surface elevations in MODFLOW. The rivers in the basin were modeled with the RIV1 package. In order to use the RIV1 package, the conductivity value (C, $m^2$/day) must be entered. In addition, water surface elevation and river bottom elevation should be entered for the river. The water surface elevation of the lake in the northeast of basin was entered as specified head using the CHD1 package. DRN1 package is used to model the drains in the basin. In DRN1 package, the conductivity value (C) of the channel and the bottom elevation of the drain must be specified. RCH1 package was used for precipitation in the basin and EVT1 package was used for evapotranspiration (ET). EVT1 package requires the maximum ET rate and the extinction depth to which the evapotranspiration will be applied.

The constant head boundary condition was used for rivers along the eastern, northern, and southeastern boundaries of the basin. Other boundaries were specified as impermeable boundary. Hydraulic conductivity was determined by calibration using the PEST (Parameter Estimation) model within the range of 5 to 500 m/day. In PEST simulations, the observed groundwater levels were compared with the values calculated by MODFLOW. After the calibration was completed, the groundwater distribution of the basin was determined for all years.

## Results and Discussion

Groundwater distribution of study area for years 2013, 2014 and 2015 are given in Figures 3, 4 and 5 respectively. The calculated heads of each well were compared with the observed heads are also given for years 2013, 2014 and 2015 in Table 1, 2 and 3 respectively.

  

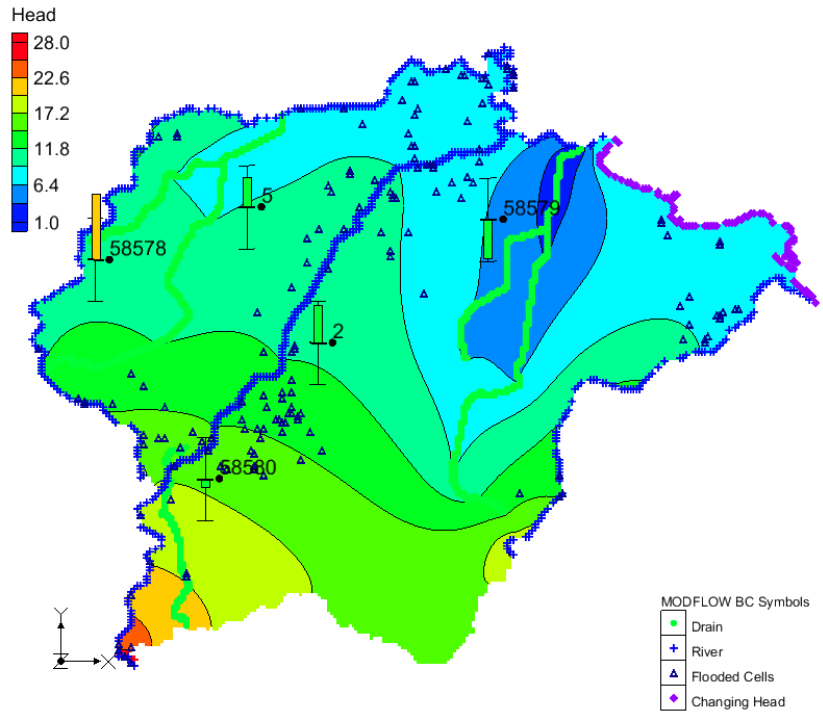


**Figure 3**. Groundwater level distribution of the basin for 2013

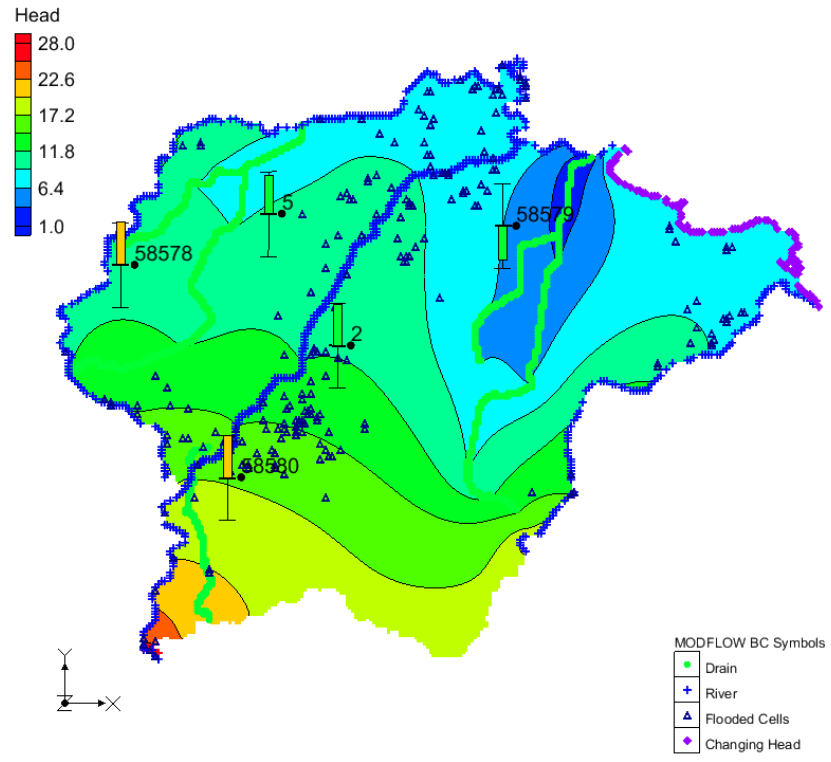


**Figure 4**. Groundwater level distribution of the basin for 2014

  

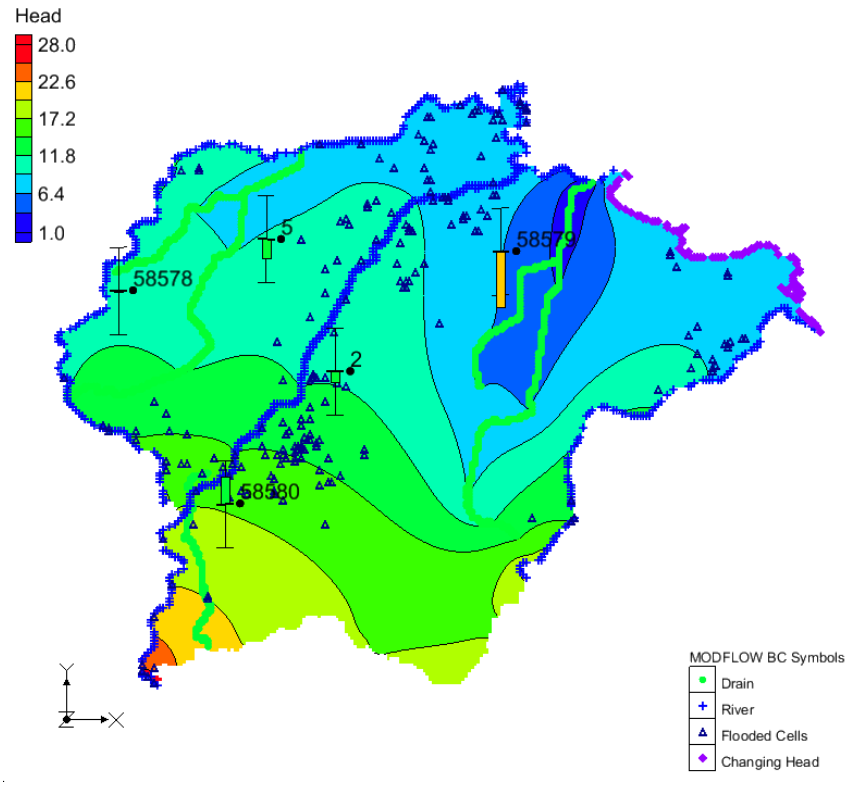


**Figure 5**. Groundwater level distribution of the basin for 2015

After PEST run and calibration hydraulic conductivity is found 50 m/day. From the residuals it can be seen that the accuracy of the model is high. In the year 2014, when the rainfall was higher and the evapotranspiration was lower, it is observed that the water level is slightly higher compared to the year 2013.

In 2013 it is observed that the highest errors were detected in the northwest of the basin, while the lowest error occurred in the southern part with high elevations. In 2014, the errors are higher in the eastern part of the basin and the calculated values are generally higher than the measured ones. In the year 2014, when the rainfall is highest and the evapotranspiration is lowest, it is seen that the water level is slightly higher compared to other years, as expected. In 2015, when the evapotranspiration value increased compared to the previous year, it is observed that the errors are high in the northeastern part with the lowest elevations in the basin. The water levels obtained for 2015 are generally lower than those observed.

**Table 1**. Residual errors of each well in the basin for simulation year 2013

| Well code | Observed Data (m) | Computed Data (m) | Residual (m) |
|---|---|---|---|
| 5 | 7.8891 | 9.3256 | -1.44 |
| 58578 | 7.8243 | 10.9697 | -3.15 |
| 58579 | 7.4748 | 5.6273 | 1.85 |
| 58580 | 16.9079 | 16.5209 | 0.39 |
| 2 | 9.3069 | 11.1109 | -1.80 |

  

**Table 2**. Residual errors of each well in the basin for simulation year 2014

| Well code | Observed Data (m) | Computed Data (m) | Residual (m) |
|---|---|---|---|
| 5 | 7.6238 | 9.4706 | -1.85 |
| 58578 | 8.9973 | 11.0282 | -2.03 |
| 58579 | 7.3584 | 5.7836 | 1.57 |
| 58580 | 14.7926 | 16.7947 | -2.00 |
| 2 | 9.4538 | 11.3974 | -1.94 |

**Table 3**. Residual errors of each well in the basin for simulation year 2015

| Well code | Observed Data (m) | Computed Data (m) | Residual (m) |
|---|---|---|---|
| 5 | 10.3528 | 9.4611 | 0.89 |
| 58578 | 11.1206 | 11.0257 | 0.09 |
| 58579 | 8.3511 | 5.7725 | 2.58 |
| 58580 | 15.4729 | 16.7174 | -1.24 |
| 2 | 11.8770 | 11.3577 | 0.52 |

## Conclusion

In this study, a numerical model of groundwater distribution in the Susurluk basin within the boundaries of Karacabey and Mustafakemalpaşa districts of Bursa province was developed. The basin hydrological features were drawn as shape files in GIS environment and then they were transferred to the MODFLOW interface, namely, GMS. The necessary data was mapped to MODFLOW grid. Modeling of the basin was made in steady state. Hydraulic conductivity values were determined using the PEST model. Generally, an agreeable fit was observed between simulated and observed hydraulic heads. In days of excessive precipitation and low evapotranspiration groundwater levels increased. An important part of the basin is composed of alluvial lands and hence the high hydraulic conductivity caused the water to spread more easily in the aquifer resulting in a very slight annual fluctuation. Model errors may decrease further by calibrating the hydraulic conductivity regionally considering the geological structure. It is believed that more realistic results can be obtained if modeling is done in transient state conditions. It would be advantageous to include these results in the planning of the water supply in the study area.

## Acknowledgements

The authors would like to express their gratitude to the 1st Regional Directorate of State Hydraulic Works for providing support in field studies and data acquisition.

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# THE EFFECT OF HOP α-ACIDS ON THE ALCOHOLIC FERMENTATION PROCESS AND THE ETHANOL YIELD

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**Abstract:** The alcoholic fermentation is exposed to a high risk of microbial infections, which have a significant impact on the efficiency of the process and the quality of the distillates. This article presents the effect of lactic acid bacteria on an alcohol fermentation by yeast and a method of reducing this undesirable microflora with the use of a preparation of hop α-acids. The results indicate that the application of hop α-acids preparation allows reducing the development of microbial infection, which are mainly lactic acid bacteria. Besides, it allows an ethanol yield to be improved. The solution is as a pro-ecological and agreeing with EU politics.
**Keywords:** hop α-acids, fermentation, native starch, lactic acid, rye

## Introduction

Bacterial contaminants in alcoholic fermentation lead to the formation of undesirable by-products and cause losses in the efficiency of alcohol. Lactic acid bacteria are the most troublesome microorganisms occurring during the production process of agricultural distillate, because they develop quickly in the fermentation environment, with the presence of carbon dioxide, especially in the phase of yeast propagation, at 30-40 °C, at low pH values. The causes of pollution may depend on the purity and quality of raw materials, yeast, fermentation tanks, transmission lines, heat exchangers, etc. (Reed & Nagodawithana, 1991). In factories producing malt whiskey, in which mash is not boiled to preserve the activity of natural malt enzymes, bacterial contamination may deteriorate the quality of distilled spirit and reduce the final yield of this high-quality fermentation product (Walker & Hill, 2016). The strains of lactic acid bacteria isolated from samples from the distillery environment were characterized by high activity during alcoholic fermentation, probably as a result of their adaptation (Bischoff, Skinner-Nemec, & Leathers, 2007; Schell et al., 2007; Skinner & Leathers, 2004). In industrial practice, determining the number of bacteria in many distilleries is often limited to the detection of lactic acid, because aerobic and facultative anaerobic bacteria with low pH tolerance are not considered a serious threat to product quality and production efficiency. The number of bacteria can be significantly reduced by cleaning and disinfecting the equipment, keeping mash at temperatures above 70 °C, using pressure-thermal methods or chemically sterilizing the substrates and adding antibiotics such as penicillin (Ralph, 1981; Rückle & Senn, 2006) or virginiamycin (Arshad, Zia, Asghar, & Bhatti, 2011; Islam, Toledo, & Hamdy, 1999). However, this is doubtful from an economic point of view, but it is even more important to raise awareness and thus also fears of the growing spread of bacterial resistance due to the huge abuse of these compounds. Despite the above precautions, bacterial contamination still occurs in many ethanol plants. Large counts of bacterial cells cause a decrease in the growth and metabolism of yeasts, caused by competition for available nutrients, but also the excretion of toxic metabolites, such as lactic acid in the case of bacteria (Oliva-Neto & Yokoya, 1994). Therefore, it is necessary to take actions to limit undesirable microflora in ethanol fermentation.

All conventional antibacterial agents in the production of ethanol show some deficiencies in the antimicrobial activity (depending on the type of bacteria, selectivity, and yeast status, chemical stability in fermentation conditions (Essia Ngang, Letourneau, & Villa, 1989) or environmental safety concerning animal and human health. that the European Union has banned the use of antibiotics as bactericidal compounds, including in the distillery industry, because the remaining decoction is used as animal feed.

Despite many research efforts aimed at reducing undesirable bacterial flora, this is still a serious problem that poses a threat to the dynamic development of commercial alcohol production. Traditional methods for keeping bacterial contaminants at an acceptable level include introducing a very low pH, for example between 2 and 3 (Gibson, Lawrence, Leclaire, Powell, & Smart, 2007) with sulfuric acid (H2SO4). Proecological techniques are based on the age-old knowledge about the hop, which can provide not only a beneficial taste of various beverages, but also protection against the development of bacterial microflora (Simpson & Smith, 1992; Suzuki, Iijima, Sakamoto, Sami, & Yamashita, 2006).

  

The antibacterial properties of hop (*Humulus lupulus*) have been known and used in the brewing industry for ages (Verzele & De Keukeleire, 1991).

The topic of this work is to present the effect of hop α-acids in inhibiting the development of unfavorable bacteria during the alcoholic fermentation and yield of the process.

## Materials and Methods

For preparing the mashes, rye of the variety Dańkowskie Amber (Danko Hodowla Roślin sp. O.o., Choryń) was used. The physical and chemical analysis of the raw material, including determination of dry mass, protein, reducing sugars and starch content was carried out following the methods recommended in the agri-food industry (AOAC, 1995).

Starch hydrolysis was carried out using amylolytic preparations such as: GC 626 liquefying enzyme preparation, containing the acid α-amylase (EC 3.2.1.1), derived from *Trichoderma reesei*, at a dose of 0.3 mL per 1 kg of raw material and the second saccharification preparation Stargen 002, which contains a blend of *Aspergillus kawachi* α-amylase (EC 3.2.1.1) expressed in *Trichoderma reesei* and glucoamylase (EC 3.2.1.3 from *Trichoderma reesei*) in an amount of 1.2 mL per kilogram of raw material. All the enzyme preparations were purchased from DuPont TM Genencor® Science (USA).

A commercial preparation of dry distillery *Saccharomyces cerevisiae* yeast, Ethanol Red (Fermentis, Division of S.I. Lesaffre, France), was used at 0.3 g $L^{-1}$ mash. The yeast was hydrated and disinfected (15 min, at room temperature) using water and sulfuric acid (25% w w-1) solution (pH of yeast slurry was set at 2.0). Along with the yeast medium, a mineral nutrient for yeast - an aqueous solution of $(NH_4)_2HPO_4$ at a dose of 0.2 g $L^{-1}$ mash was added. A preparation IsoStab® (BetaTech, Germany) of hop α-acids in an amount of 140 ppm was added.

The mashes were prepared with pressureless liberation of starch method (PLS), using a previously ground raw material, in a mill equipped with corundum and ceramic grinders (crumbling below 1.5 mm). The process was carried out in a mixer equipped with a stirrer disposed of in the water heating mantle.

The hydrolysis of native starch consisted of mixing the ground grain with water (in a ratio of 1: 2.8), the pH was adjusted to 4.0 with use of a solution of sulfuric acid 25% w $w^{-1}$, then the mixture was heated to a temperature of 35 ± 2 °C, and next the GC 626 enzyme preparation was added, these conditions were maintained for 30 minutes in order to pre-hydrolyze a starch(so-called ‘activation'). Then, stirring constantly, the mash was cooled to the fermentation temperature (35 °C) and the pH was controlled and possibly re-adjusted to 4.0, after which STARGEN 002 was added. For the samples of mashes of the second variant, the hop α-acid preparation was additionally added. Then all the samples were treated with yeast and nitrogen medium. The process was conducted at 35 °C for 3 days.

During fermentation, samples of the mash were collected (every 24 h) to determine the content of sugars and ethanol. Once fermentation was complete, the ethanol was distilled from the mash using a laboratory kit consisting of a Liebig cooler, a flask, and a thermometer. The distillates obtained, containing 20–30% (v $v^{-1}$) ethanol, were strengthened to ethanol contents of approximately 43% (v $v^{-1}$) in a glass distillation apparatus with a special dephlegmator/condenser, according to the method described by Golodetz (Hulda, Njintang, & Cmf, 2017).

The raw materials were analyzed to determine its content of moisture, total nitrogen (AOAC, 1995), reducing sugars (Pomeranz & Meloan, 1995) and starch (BS EN ISO 10520:1998, 1998) using recommended methods in the agricultural and food industries.

Before and after fermentation, the contents of total sugars and reducing sugars in the distillery mashes were determined according to the recommended methods for the distilling industry (AOAC, 1995) expressed in g of glucose per L of mash. Dextrin content (expressed in g $L^{-1}$ of mash) was calculated as the difference between the amounts of total sugars and reducing sugars, taking into account the conversion coefficient (0.9) into dextrins.

Analysis of the sugar profile was performed on high-performance liquid chromatography (HPLC). An Agilent 1260 Infinity apparatus (Agilent Technologies, USA) was used, equipped with a refractive index detector (RID) (temperature set at 55 °C). A Hi-Plex H column (7.7 × 300 mm, 8 µm) (Agilent Technologies, USA) was used to separate the compounds. The column temperature was maintained at 60 °C. As a mobile phase, 5 mM of H2SO4 was used at a flow rate of 0.7 mL min-1. Before analysis, mash samples were deproteinized and filtered through a 0.45 µm PES (polyethersulphone) membrane, then injected at a volume of 20 µL (Hulda et al., 2017)

  

(Strąk-Graczyk & Balcerek, 2019)

Based on the obtained results, the fermentation factors were calculated, i.e. the intake of sugars and fermentation yield (in relation to total sugars determined in the sweet mash).

## Results and Discussion

The raw material used in the research was characterized by a dry matter (d.m.) content at the level of 87.1±1.7%. With reference to literature data (Pietruszka & Szopa, 2014), it indicates that the tested raw material was characterized by low water content (Tab.1). In the case of distilleries working in the all-season system, the moisture of the raw material is a significant parameter, which affects possible storage of cereal grain. The processed raw material contained a protein at the level of 11.9±0.2%, which was higher than in rye grains described in the literature. On average, the total protein content in cereals is between 10% and 12% (w $w^{-1}$) (HGCA, 2018) but the kinds of protein in each variety of cereals have not accurately been described (Villegas-Torres, Ward, & Lye, 2015). Only about 10% – 15% of the total protein is dissolved during mashing. The unhydrolyzed residue remains along with leftovers from the raw material in the medium (Bringhurst & Brosnan, 2014). The content and types of proteins in grains affect the ethanol yield, which is related to the degree to which the starch granules are embedded in the protein matrix. The strength of protein adhesion and the biomechanical properties of the layers cereal grains play an important role in the processing of the raw material, and subsequent hydrolysis of the granules (Agu et al., 2012).The rye used for research was characterized by starch content at the level of 68.5±1.4%, which is similar to the literature data (Pietruszka & Szopa, 2014) and indicates the usefulness of grain for distillation purposes.

**Table 1**: The physicochemical composition of rye grains.

| Raw material | Dry matter [%] | Protein [% d.m.] | Reducing sugars [g glucose/100 g raw material] | Starch [g/100 g raw material] |
|---|---|---|---|---|
| Rye Amber cultivar | 87.1±1.7$^{b}$ | 11.9±0.2$^{b}$ | 1.8±0.4$^{a}$ | 68.5±1.4$^{a}$ |
| Literature data (Pietruszka & Szopa, 2014) | 80.5±0.02$^{a}$ | 9.4±0.05$^{a}$ | 4.4±0.01$^{b}$ | 67.8 ± 0.3$^{a}$ |

Different superscript letters in columns indicate significant differences (P <0.05) between mean values.

Based on the results of the analysis of reducing and total sugars concentrations in the medium after pre-hydrolysis, the efficiency of starch saccharification ('activation') was calculated and expressed in % of its total content. This allowed the evaluation of enzymes performance depending on the variant of prepared samples. Figure 1 shows the results of pre-hydrolysis of rye starch.

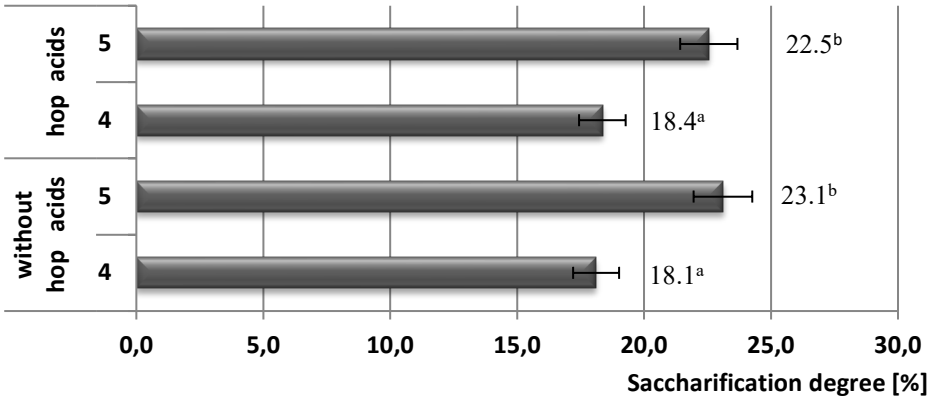


**Figure 1** Efficiency of initial rye starch saccharification for two initial pH of medium (pH 4.0 or pH 5.0), and without or with the addition of hop α-acids preparation. Different superscript lowercase letters indicate significant differences (P <0.05) between mean values.

  

Because hop α-acids preparation was added just before the task of yeast testing, we cannot determine their effect on the starch 'activation' step. However, by this indicator, it can be concluded that the acid α- amylase present in the enzyme preparation GC 626 used for the initial hydrolysis showed higher activity in mashes with initial pH 5.0. Chemical analysis of sweet (Tab. 2) and fermented (Tab. 3) mashes included pH measurement and evaluation of sugars (glucose, maltose, maltose), and dextrins concentrations. Moreover, samples were taken every 24 h to determine the lactic and acetic acid concentrations (as indicators of microbial infection) and ethanol content.

**Table 2**: Chemical composition of sweet mashes.

| Mashes before fermentation | pH | Concentration of sugars [g $L^{-1}$] | | | Dextrins [g $L^{-1}$] |
|---|---|---|---|---|---|
| | | glucose | maltose | maltotriose | |
| With hop acids | 4±0.1 $^{a}$ | 21.2±0.6 $^{b}$ | 0.3±0.1 $^{a}$ | 0.1±0.1 $^{a}$ | 150.6±2.8 $^{a}$ |
| | 5±0.1 $^{a}$ | 39.5±1.1 $^{d}$ | 0.4±0.1 $^{a}$ | 0.5±0.1 $^{a}$ | 143.8±2.7 $^{a}$ |
| Without hop acids | 4±0.1 $^{a}$ | 18.9±0.5 $^{a}$ | 0.3±0.1 $^{a}$ | n.d. | 149.1±2.8 $^{a}$ |
| | 5±0.1 $^{a}$ | 29.8±0.8 $^{c}$ | 0.5±0.1 $^{a}$ | 0.2±0.1 $^{a}$ | 147.6±2.9 $^{a}$ |

n.d. – not detected; different superscript letters in columns indicate significant differences (P <0.05) between mean values.

**Table 3**: Chemical composition of fermented mashes.

| Mashes after fermentation | initial pH | pH after 72 h | Concentration of sugars [g $L^{-1}$] | | | Dextrins [g $L^{-1}$] | Ethanol [% v $v^{-1}$] |
|---|---|---|---|---|---|---|---|
| | | | glucose | maltose | maltotriose | | |
| With hop acids | 4±0.1 $^{a}$ | 3.8±0.2 $^{a}$ | 0.1±0.1 $^{a}$ | n.d. | 0.3±0.1 $^{b}$ | 0.9±0.1 $^{a}$ | 11.7±0.6 $^{b}$ |
| | 5±0.1 $^{a}$ | 4.4.±0.1 $^{b}$ | 0.2±0.1 $^{a}$ | 0.1±0.1 $^{a}$ | 0.1±0.1 $^{a}$ | 1.9±0.1 $^{c}$ | 9.6±0.5 $^{a}$ |
| Without hop acids | 4±0.1 $^{a}$ | 3.5±0.1 $^{a}$ | 0.2±0.1 $^{a}$ | 1.0±0.1 $^{b}$ | 0.1±0.1 $^{a}$ | 0.9±0.1 $^{a}$ | 10.3±0.5 $^{a}$ |
| | 5±0.1 $^{a}$ | 4.2±0.1 $^{b}$ | 0.1±0.1 $^{a}$ | 0.2±0.1 $^{a}$ | 0.1±0.1 $^{a}$ | 1.6±0.1 $^{b}$ | 9.5±0.5 $^{a}$ |

n.d. – not detected; different superscript letters in columns indicate significant differences (P <0.05) between mean values.

In mashes before fermentation, the concentration of glucose was higher in samples with initial pH 5. As mentioned above, the acid α-amylase reveal a higher activity at pH 5 than at pH 4. During 'activation' of starch, glucose was the most liberated sugar, followed by maltose, and the lowest in maltotriose, for both pH variants. It is mainly caused by the enzyme mechanism. Despite significant differences in concentrations of sugars determined upon completion of fermentation, it can be observed that all mashes, regardless of the starting pH, have been fermented properly. The lowest concentrations of unutilized glucose, maltose, maltotriose were determined in mashes supplemented with hop α-acid preparation, with initial pH 4 (Table 3). Taken into consideration the dextrin content in mashes, it can be suppose that the saccharification enzymes did not manage to break them down to the simple sugars available for yeast. The lowest dextrin content in the fermented mash with initial pH 4, and supplemented with hop α-acids preparation is reflected in the highest ethanol content (11.7±0.6% v $v^{-1}$) with comparison to the remaining variant.

Sweet mashes and mashes during fermentation were examined microbiologically. The results obtained for samples collected once every 24 h are shown in Figures 2 and 3.

  

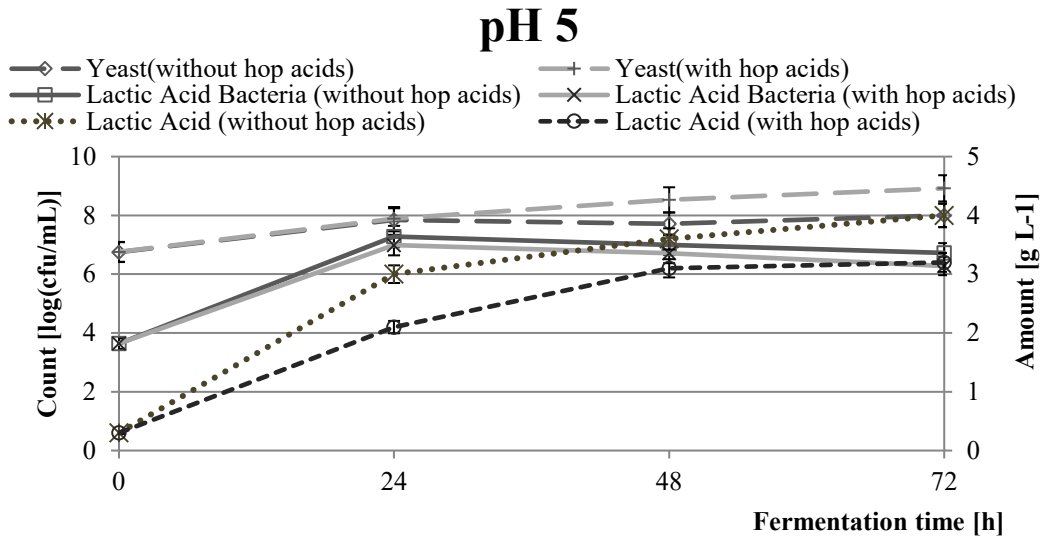


**Figure 2** Microbiological analysis of mashes with initial pH 5, during fermentation.

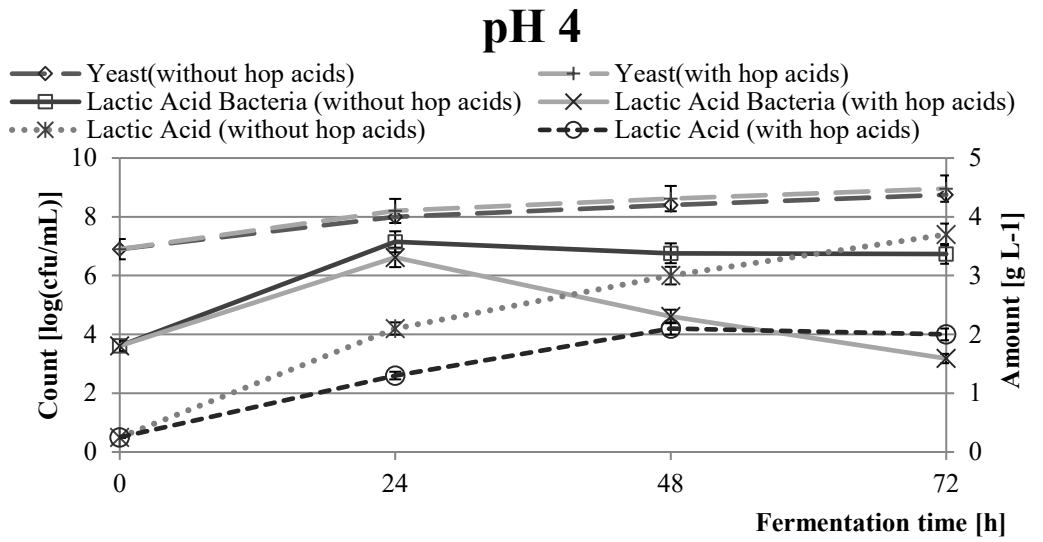


**Figure 3** Microbiological analysis of mashes with initial pH 4, during fermentation.

Furthermore, during fermentation, lactic acid content was determined in the mashes (Figs. 2 and 3). The main sources of the microbial contaminations of distillery mashes are raw materials, yeast, equipment, water, and air. This is a serious problem for producers of raw spirit. Yeast and lactic acid bacteria are often found together in natural ecosystems and can compete for the same nutrients. When both microorganisms develop and live together in a specific medium, in which yeast growth is limited by providing suboptimal vitamin concentrations, missing substances (including nicotinic acid, adenine, guanine, aspartic acid, tryptophan, glycine, alanine or lysine) necessary for growth *Lactobacillus* spp. are synthesized in the medium by yeast cells (Narendranath, Hynes, Thomas, & Ingledew, 1997). The obtained results indicated a decrease in pH from 5 to 4, which limits the growth of undesirable lactic bacteria. It was observed that regardless of the initial pH of the mashes, the number of lactic bacteria cells in the medium before the fermentation was at a similar level of 3.63±0.79 log CFU $mL^{-1}$, while the concentration of lactic acid in mashes reached 0.03±0.01 g $L^{-1}$. After 24 hours of fermentation in reference mashes(without the addition of hop α-acids preparation), more than 2-fold increase in the number of bacteria cells was noted, and in samples with initial pH 4 reached 7.15±0.29 log CFU $mL^{-1}$, while for those with pH 5 amounted

  

7.82±0.32 log CFU $mL^{-1}$. The addition of hop α-acids preparation to the mashes with the initial pH 4.0 allowed to reduce the number of lactic acid bacteria after 72 h of the process to 3.18±0.1 log CFU $mL^{-1}$, whereas in the mashes with the initial pH 5.0, lactic acid bacteria count was 6.28±0.2 log CFU $mL^{-1}$. Also, the content of lactic acid, in comparison to the control samples (without hop α-acids), decreased by 1.7 g $L^{-1}$ for pH 4, and by 0.44 g $L^{-1}$ for pH 5. The count of bacteria decreased with the increase in the final lactic acid concentration, when lactic acid together with ethanol were present in the mashes. This suggests that ethanol acts synergistically with lactic acid to kill these bacteria and that the toxicity of ethanol is increased by the drop in pH caused by lactic acid in the medium.

Suzuki (2011) stated that hop acids affect not only the exhaustion of proton strength and by the capture of divalent cations, such as $Mn2^{+.}$ They disrupt the enzymatic processes of proteins involved in energy production and redox mesostase in a bacterial cell.

The disturbance of the membrane mechanism, cellular processes, and intracellular acidification results in inhibition of the active transport of sugars, nutrients and amino acids through the membrane, and thus interruption of the respiration and synthesis of protein, DNA and RNA, ultimately cell death leading to its death (Doyle & Roman, 2016).

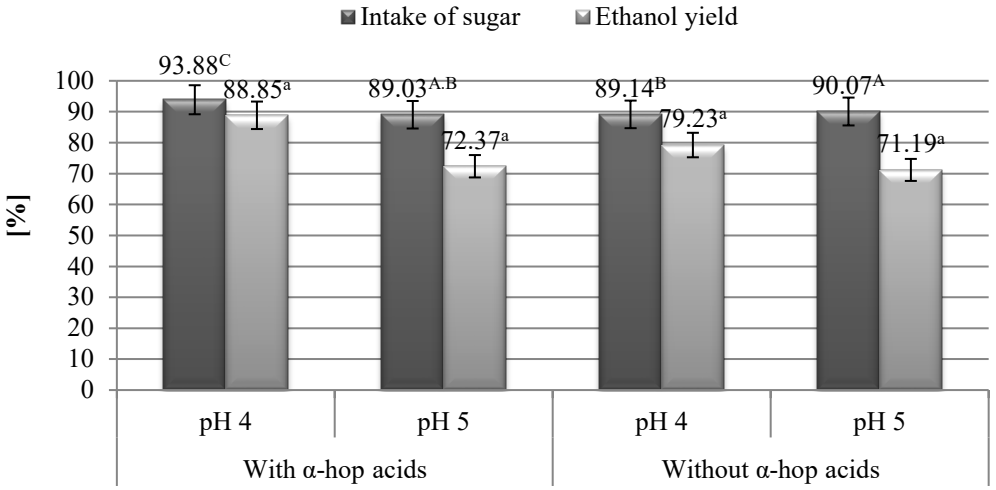


**Figure 4** Ethanol fermentation factors.

Different superscript capital letters indicate significant differences (P <0.05) between mean values of sugars intake.
Different superscript lowercase letters indicate significant differences (P <0.05) between mean values of ethanol yield.

The activity of lactic acids has been shown to decrease the yeast growth rate, sugar consumption, and ethanol yield (Strąk & Balcerek, 2015; Thomas, Hynes, & Ingledew, 2001). Lower ethanol contents and fermentation efficiency were observed in trials exhibiting more severe bacterial contamination (Tabs. 2,3 and Figs. 2-4).

Only a 1% drop in ethanol yield is of great importance for food alcohol distillers because their profit margin is very narrow (Makanjuola, Tymon, & Springham, 1992). In large plants with capacities from 400 million to 1100 million liters of ethanol per year, such a decrease would reduce income by 1 million to 3 million per year (Narendranath et al., 1997). Research on the direct effects of process contamination is not easy to carry out (Makanjuola et al., 1992).

Estimation of the ethanol fermentation factors showed that the lower pH of the mashes (at the level of 4), and the use of α-hop acids preparation allowed to improve the efficiency of the process by 5% comparing to the control sample. On the other hand, raising the pH to 5, resulted in a 5% decrease in the yield, despite the use of hop acids preparation. In all tested mashes, the intake of sugars by yeast was at a similar level (Fig. 4).

## Conclusion

Bacterial contamination of the fermentation medium is the main cause of the reduction of ethanol yield during the fermentation of starchy raw materials. Among the bacterial contaminants encountered, lactic acid bacteria are the

  

most troublesome, because of their tolerance to high temperature and low pH and the ability to grow quickly. The obtained results indicate that the use of hop α-acids preparation allows reducing the development of microbial infection, which are mainly lactic bacteria. Also, it allows an ethanol yield to be improved. Taking into consideration, that the starchy raw materials, among others cereal grains, may include contaminating bacteria, which compete with the yeast on growth-promoting nutrients, there is a need to apply addition to distillery mashes of antimicrobial preparations, to improve production technologies and obtain products of the highest quality.

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